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Electrical Switches. THE very useful paper by Mr. Offrell which we publish this week, gives a great deal of valuable information on a subject of considerable importance. Questions as to proper size and construction of switches for various uses are often asked, and the present paper, which embodies the results of an extended practical experience, answers them clearly. Specially interesting are the suggestions for high tension switches, and the very simple rule for current density over areas of contact. Such practical directions from practical men are of great service in extending our knowledge of the actual methods found serviceable in the applications of electricity.

An Electric Train Signal. WE illustrate this week an apparatus which has found considerable favor during its experimental introduction. Some ready and convenient method of establishing complete communication between the conductor and engineer of a train is unquestionably a desideratum, and the signaling system in question appears to have many of the elements of success. Specially to be commended is that feature of the couplers that automatically sends a signal to the engineer when the connection between cars is broken. Accidents from wild cars have been by no means infrequent occurrences, and it is of great service to have immediate knowledge of any casual uncoupling that may chance to exist. No better agent can be found than electricity for performing such a service, and sooner or later some system like the present one is likely to find its way into general use.

Electric "Freaks" IF there should ever be formed the projected trades-union within the more select dime museum circles, we should like to bespeak a position as walking delegate for the electrical perpetual motion crank. He has been turning up rather frequently of late, with dynamos of a hundred and fifty per cent. efficiency, storage batteries that drive motor-dynamos wherewith to charge themselves and run the earth, modified beer faucets for tapping earth currents, and other devices that should secure him an honored place alongside the toothed hen and the woolly man from Borneo. It is really singular to note the frequency with which schemes appear that involve or imply perpetual motion. A useful adjunct to the electrical fraternity would be an active missionary society to promulgate the doctrine of the conservation of energy among the unscientific heathen.

Electrical Road Vehicles. AMONG the multitude of various applications of the electric motor, its use for propelling light vehicles seems to be one of the reasonable probabilities. There are many sections of the country, specially in suburban towns, where the roads are uniformly smooth and good, and therefore well adapted for such an experiment. A practical electrical tricycle would be a lazy man's delight, and as the electric light is generally available, power for charging the batteries would not be hard to find. Tolerable success has already been attained with such machines. The power required is not large, and the necessary weight of batteries and motor can be brought within quite reasonable limits. It would not be a difficult matter to bring out such a machine, and it would probably find a considerable number of users in favorable localities.

Electricity from Heat. THE daily press has grown excited recently over a report from Hartford, Conn., that a new and marvellous method of generating electricity has been discovered. It was described as a direct process by which electric currents could be generated by heat. Those most immediately interested in the invention are, however, quite conservative in their statements and not inclined to make sweeping claims until further experiments have been made. It will be remembered by many of our readers that a similar report arose some eight or ten years ago, having for its tangible but insufficient basis a pyro-electric battery that soon disappeared from public view. More recently the pyro-magnetic generator created a briefer flurry. In view of past experience, we should be cautious in accepting reports of a similar kind, and should withhold judgment until the means taken to secure the alleged extraordinary result are made public and experiments have proved or disproved the claims that for the present come rather from the newspapers than from the inventor.

A Formidable Torpedo. IN no field of invention has more ingenuity been spent by modern man than in devising neat and effective methods of killing his fellows by wholesale. With the growth of electrical arts these warlike applications have received a new impulse, and it seems as if electricity were to play an important part in the development of new methods of offense and defense. We give this week some account of the progress made in the improvement of a remarkable submarine torpedo-boat, the original model of which was illustrated in our columns last autumn. The Halpin-Savage torpedo-boat appears to be a particularly ugly customer to meet on a dark night in a narrow channel. It is not simply an automobile and dirigible torpedo, but a true submarine torpedo-boat, with no machinery above water exposed to the fire of machine guns, with no crew to be endangered, and yet as dangerous a foe as if the guiding intelligence were on board instead of being at the further end of a wire three or four miles long. Up to the present the torpedo has not been a formidable factor in offensive warfare, but this type of submarine boat, having an effective range of five miles and under perfect control from the shore, is a most dangerous adversary.

Rating Arc Lamps. WHY do we continue the old and guileful method of rating arc lamps by their so-called candle power? In the first place, there is no conventional direction in which the light should by common consent be measured, and even if there were, the distribution of the light is not taken into account. In the second place, everybody knows well enough that the alleged 2,000 candle power lamp seldom or never gives even 1,000 measured in any useful direction, while its more modest competitor, the 1,200 candle power lamp actually gives less than 500 effective candle power. The nominal ratings have come to be mere trade names that do not serve to deceive and only create confusion. It would be vastly better to rate the arcs by the energy consumed in watts. On this classification the 2,000 candle power arcs would be rated as 500-watt lamps, and the 1,200 candle power arcs as 300-watt lamps. The actual energy is slightly less than these figures, but contracts would naturally be made to call for arc lights consuming over 450 and less than 500 watts, and the like. With such an arrangement it would be perfectly easy to show that contractors had conformed strictly to the specifications, and considerable wrangling would be averted. The plan is a simple one to carry out, and would obviate most of the present misunderstandings.

Lighting Railway Trains. THE electric light is quite certain eventually to find its way into railroad service to the exclusion of lamps and gas. Next to the car stove, perhaps the car lamp is responsible for more dreadful results than any other article of railroad equipment. The difficulties in the way of introducing electric lights have been great, owing partly to the conservatism of corporations and in part to a feeling of distrust in the method proposed. The alternative has hitherto been between storage batteries and a direct supply from a dynamo and engine operated by steam from the locomotive boiler. On the one hand was the weight and care of the batteries, on the other hand the necessity for a continuous light even if the engine were changed. Mr. Gibbs of the Chicago, Milwaukee & St. Paul Railroad Company has faced the dilemma squarely and has modified the usual plans by constructing the special tender described in this issue. It may be considered as a portable electric lighting station and is to form a regular part of the train, supplying both electric light and steam heat. This plan has much to recommend it on the score of convenience and safety, and its weight, hardly more than that of a loaded freight car, does not seem to constitute a serious objection. It seems a good expedient, although we cannot help feeling that ere long the storage battery will take possession of the field.

Wanted—A Lightning Arrester. THE recent severe thunderstorms have done no little damage to electrical plants throughout the country, and forcibly call attention to the need of a lightning arrester that will arrest lightning, at least to the extent of protecting dynamos. It is worth noticing that there is a wide difference between the comparatively mild action of lightning on arc machines and its deadly attacks on incandescent dynamos. In the first case the field magnets and the armature, with its immense number of windings, serve as a pair of impedance coils of imposing dimensions, with the usual result of limiting the damage to a more or less serious arc across the commutator. In case of the incandescent machine, however, the field magnets serve only to force an incoming discharge to break through the armature, which, with its few windings, offers very little effective resistance. The result is a short circuit either through the core or between coils, and in either case the armature is immediately destroyed. The actual injury done by the lightning is generally slight; it is enough if it merely punctures the insulation, when the subsequent short circuit completes the work of destruction. To protect this class of dynamos then, it is necessary to head off the lightning very completely and to take elaborate precautions against dangerous short circuits. The high-tension power dynamos are especially thin skinned and create no little demand for some protective device that shall prove effectual.

"Uninsulated" Gas Mains. THE recent explosion, and the subsequent gas volcano that raged at the corner of Broadway and Fulton street for eighteen hours, endangering life and destroying property, will, perhaps, stir the public from its apathy and bring it to realize some of the many failings of the gas companies. Let an electric wire fall and distribute a few shocks, or an electric company hesitate to put its cables into defective subways, and there is an immediate howl about the reckless negligence of corporations; but apparently the gas combination has secured the inalienable right to establish and maintain defective and leaky mains, to saturate the earth with its noxious products, to imperil the lives of citizens by explosions, and to ruin the property of its competitors. If half the misapplied energy that is now spent in worrying electrical interests and demanding the fulfilment of extraordinary and useless conditions were devoted to the real protection of the public, the gas companies would have to stop this perilous and pestilent underground leakage or go out of business. A poorly insulated wire is a source of risk, if at all, only to those who handle it recklessly; and it should be remembered that electric light wires are not meant to be handled and are generally out of reach. But these carelessly laid gas pipes are a constant menace to the safety of every man, woman, and child who walks the streets of New York. Explosions caused by them have been conspicuously frequent, and even where the leaks have not caused open destruction they have so filled the earth with sickening vapors that once the pavement is removed the street is almost uninhabitable. Turn the search light of public investigation on this almost intolerable nuisance, and compel the authors of it to abate it or give way to a method of illumination that does not pollute the air nor raise volcanos on the corners of the streets.

On Designing Switches for Electric Plants.

BY OLOF OFFRELL.

In the early days of electric lighting very little attention was paid to the accessories of an electric installation, and especially to the devices known as switches. Naturally enough, as long as the dynamo and the lamp were in a primitive state, and, consequently, there was a great field for improvement in that direction, so long no attention would be given to less important matters, mere details, although quite important ones after all.

Only within the last two or three years have inventors turned their attention toward perfecting the switch, which has now become a *sine qua non* in almost every kind of electric installation; but we have now very ingenious and practical devices of this kind in the market.

The purpose of this article is to give some practical points on designing switches, brought out by experience.

One of the first points to consider in designing a switch is its capacity, that is, how many ampères of current it can safely carry over and through its contacts without appreciable heating. On this point there seems to exist a great difference of opinion. Not any two switches of the same rated capacity have approximately or anywhere near approximately equal contact surface. While a large contact surface is a decided advantage, we soon reach a limit, which we cannot pass without materially increasing the size and consequently the cost of the switch, and then the question arises, What is the smallest allowable contact surface in square inches per ampère to be carried that we can use with a factor of safety large enough to prevent any appreciable heating? The writer has found 0.01 square inch surface per ampère to be a good rule, below which it is not advisable to go. In arc light or constant current switches, which generally do not carry over 10 ampères, we can, and usually do, make the contacts a good deal larger, from 2 to 4 times, as we are here not so much restricted by a bulky appearance and cost as is the case with an incandescent switch.

It is always preferable to have contact surface on both sides of the lever carrying the current, *i. e.*, double contact springs: as, in this way, a better and more trustworthy contact is obtained. The contact springs must not be of too thin material; preferably they ought to be made of two or three thicknesses of spring copper, which are riveted to the binding post to which the conductor is secured. The very best way of securing the contact springs is to set them in grooves milled out for the purpose in the base of the binding posts and then rivet them. The contact spring ought to be split or cut up to almost its entire active length in two to four parts, depending upon the size of switch, because this makes it more flexible; and if there is an uneven spot on the contact surface of the lever, it will adjust itself to the unevenness and still make a good contact.

The contact springs or the lever must be so shaped that the lever leaves the contacts along their entire length at the same time. If it does not, the spark in throwing the switch open will concentrate itself at the point of last contact, and, in case of a heavy current, burn or fuse it.

The cross section of those parts of the switch that have to carry the current must have a conductivity according to the current to be carried corresponding to 800 to 1,000 ampères per square inch.

The action of the switch must never depend upon springs, spiral or flat, through which the current passes, as the current will invariably more or less heat and take the springiness out of them, thereby causing the switch to give out.

Never let the pivot-bearing of the lever form one terminal of the switch, as the current in passing through the bearing will heat it, no matter how carefully it is made, and sooner or later put the switch out of order. Each terminal ought to have contact springs for itself. This might make the bridge cost a trifle more, but it is a far better construction. The general practice to-day among leading manufacturers is to make such independent contacts for each terminal.

The set screws for holding the conductors in the binding posts ought to be large enough to stand a good tightening. Preferably they ought to be of iron, with square heads, so as to be tightened with wrench wherever the size of the switch allows it. The number of threads in the binding-post into which the screw engages must be large enough, so that there will be no danger of stripping the threads in tightening the screw.

In the case of a switch operated altogether by hand, without assisting springs, the lever ought to be provided with a stop device, which keeps the switch open, preventing it from accidentally closing the circuit. This is especially important in alternating current switches on the primary circuit, where an accidental closing of the circuit can endanger lives.

The handle is, of course, always made of wood or other insulating material.

The base of the switch ought to be made of fire proof, insulating material, for which slate, porcelain, hard rubber, molded mica, etc., are suitable, and is now extensively used. If the base is made of wood, the front side ought to be covered with mica, so as to prevent the spark, that possibly can be formed, from setting the base on fire.

The cover in switches for low tension currents is generally made of metal, but it must always be insulated from those parts of the switch that carry the current. On the inside of the cover is generally placed one thickness of thin vulcanized fibre.

The practice so far has been to make all station switches, whether for high or low tension, open, *i. e.*, without cover; but the probability is that before long they will be provided with an insulating covering, at least where high tension alternating currents are used, so as to prevent accidents to the attendants.

The use of single pole switches is comparatively rare, especially in distribution of electrical energy at constant potential; switches are generally made with double poles, which in every case are to be preferred, as by them a certain part of a circuit or a certain machine in a system can be completely disconnected by one movement of the switch lever. This is absolutely necessary where high tension alternating currents are used, and is compulsory wherever rules of a Board of Electrical Control or a Board of Fire Underwriters are adopted.

In order to prevent the possibility of the lever stopping at an intermediate point, whereby only a part of the contact surface would have to carry the whole current, resulting undoubtedly in destroying the switch, and further to prevent forming a spark at the instant of breaking the circuit, so-called snap switches have been invented. They are so constructed that the switch lever, once started by the operator turning the handle, is brought to its furthest position by means of one or two springs, independently of the movement of the handle. These springs are carried over the center by turning the handle to a certain point, but act from that point independently of the handle. Thus all danger of the switch stopping on an intermediate position is prevented, as is also the forming of any destructive arc in opening the circuit.

For these reasons all switches outside of central stations ought to be made "snapping," *i. e.*, to quickly close and open the circuit independently of the speed with which the operator turns the handle. There are several meritorious designs on this principal in the market.

Constant current switches are made on a somewhat different principle from constant potential switches, as in this case the circuit must never be opened. The duty of a constant current switch is to cut out a certain loop or part of the circuit; but as the loop carries the whole current, it would interrupt the service on the whole line to open the circuit in the loop. The switch must therefore short circuit the loop before it disconnects it. Even these switches are made "snapping," although there is no absolute necessity for it if the short circuiting is properly done before the cutting out.

As a conclusion, I will say a few words about the latest developments in switches, which I have been recently engaged in designing, and in which the most important conditions for a first-class switch are fulfilled. These switches are to be used on the alternating circuits in connection with the underground cables in the New York subways to disconnect converters from the main circuit.

The requirements to be fulfilled by these switches are that they shall be water, moisture and fire proof, and have an insulation resistance at least equal to that of the underground cables; in addition to which they must be so arranged that moisture cannot enter the insulation of the exposed ends of the cables terminating in the binding posts. The cables from the subway enter a cast iron box at one end, passing through a special kind of clamp screwed into projections on the outside of the box. These projections are made hollow to receive insulating cups, through which the cables pass to the binding-posts. The cups are filled with insulating compound after the cables are in place, which then surrounds the bare ends of the wire, preventing moisture from entering the insulation. The cables leading to the converters pass through pieces of gas-pipe screwed into corresponding holes on the opposite side of the box, and are soldered to them.

The switch is a double pole quick break switch, which is mounted on a hard rubber base. The switch stem projects outside the box through a stuffing-box in the lid, and can be operated from the outside by a handle, or the lid is screwed on and made watertight by means of soft rubber and cement.

Mordey Alternating Motors.

It seems that there is a misapprehension at the bottom of a belief, current in England of late, that Mr. Mordey had mistakenly claimed priority in what others had already done, namely, the running of alternating dynamos in parallel. The blunder popularily attributed to so well-known an electrician was not to be credited until thoroughly confirmed; and, on the contrary, the facts dispel the idea completely.

What Mr. Mordey pointed out was that alternate-current dynamos could be run in parallel without the necessity for large self-induction and resistance, which was maintained by Forbes, Hopkinson, Kapp, Swinburne and others to be a necessary concomitant. They admitted that these would be an evil in other respects, and what Mr. Mordey stated and proved was that they were unnecessary in parallel running, and in this he certainly has priority. Previous work was very fully referred to in his paper (*Journal*, Institution of Electrical Engineers, xviii., 584-5). He quoted opinions by such authorities as Forbes and Kapp, expressed within a few weeks of the reading of his paper, that the qualities necessary to secure successful parallel working were the qualities that on every other ground should be avoided. The position he took is then still unaltered, and the running of Mordey dynamos as alternate motors requires nothing but the demand to become quite as usual an occurrence as the installation of an alternating dynamo. From time to time experiments have been made to demonstrate the practicability of such a course. Quite recently Mr. Mordey has tested a 33 h. p. alternator running as a motor, and has attained 33 actual h.p. from it at a high efficiency. Another experiment showed that a 160 h. p. alternator running free as a motor absorbed only 4 h. p. to excite and drive it and its exciter. The only difficulty to be overcome in running these alternate-current motors is the starting, and this is really no difficulty, for a battery of eight storage cells giving some 5 h. p. will bring the motor up to speed in five minutes, while it must be remembered that the ordinary large mill engine will usually require more than a quarter of an hour to attain full speed from the time when steam is first turned on. For a steady load, such as driving a mill would be, the action of the alternator is perfect.

Keswick Water-Power Electric Light Station.

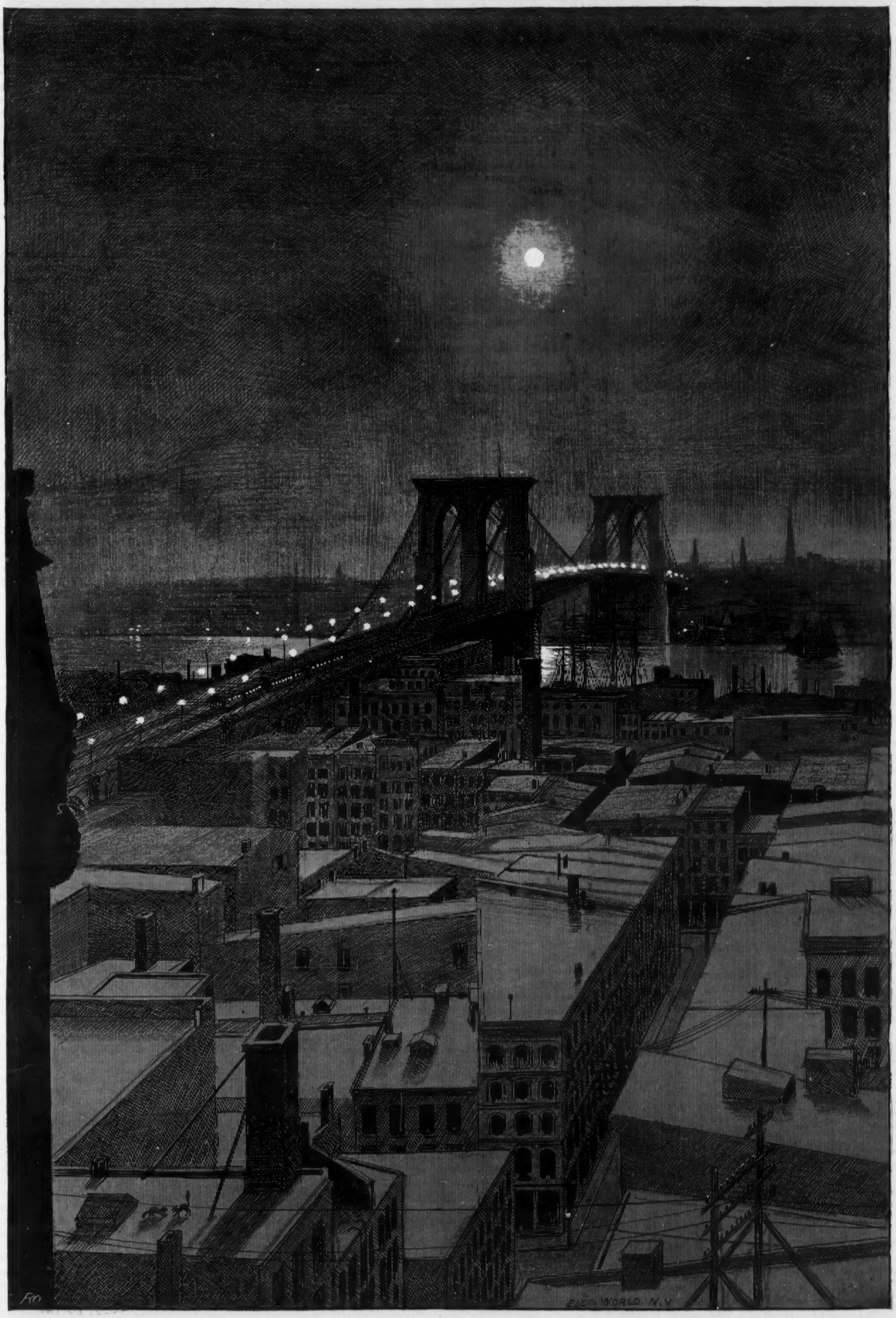
Those who have taken an interest in the simultaneous use of water and steam power for central stations (a notable instance of which, at Harrisburg, Pa., was illustrated in The Electrical World of May 17, 1890) will be glad to hear of the first attempt to utilize water power in England for the purposes of a public supply of electric light. The alternating current transformer system is employed, and the station is on the banks of the river Greta, about three-quarters of a mile from Keswick, where there is a head of 20 feet. The rent paid for the water is 10 shillings per horse power per annum. Taking the number of horse-power hours required per annum as 100,000 for the present output of the station from a 50 horse-power turbine, the cost per horse-power came out as 0.06d. On the other hand, taking the price of steam coal at 15s. per ton, and the quantity burnt per horse power per hour as 6 pounds, the cost per horse-power hour came to 0.48d. As there is, however, a possibility of partial failure of the water supply during extreme drought in summer, steam is provided in addition. The turbine is a "Victor," of a mixed-flow type; the wheel is 20 inches in diameter, and its speed is 273 revolutions per minute. The engine is a Westinghouse of simple type, having two single-acting cylinders, 10 inches diameter by 9 inches stroke; at 350 revolutions per minute, with 80 pounds of steam, it gives 50.11 B. H. P. The alternator, designed by Mr. Gisbert Kapp, and manufactured by Messrs. Johnson and Phillips, the contractors for the electrical plant, is a 30-kilowatt (15 ampères 2,000 volts) machine. It runs at 750 revolutions, and the frequency is 75. The resistance of the armature, after working some hours, has been found to be 7 ohms. The total resistance of the field, after working some hours, is 11.2 ohms. The mains are carried overhead, and special attention has been paid to obtaining good insulation at the supports by means of oil insulators. The sizes of the mains are fixed for a current density of 500 ampères to the square inch. The fall of potential between the generating station and the town is only slightly above 1 per cent. at full load. Steel suspension strand is used for supporting the mains for all circuits. One short run of underground mains on the Brooks fluid system is being tried. A series of experiments have been made to test the efficiency of the machinery, with the result that the total efficiency of the generating plant at the station came out at about 40 per cent. at one-quarter full load, and over 70 per cent. at full load.

The Brooklyn Bridge by Electric Light.

At the opening of the new year the readers of The Electrical World were made acquainted with the airy and comfortable offices that constitute its home, and something was said at that time of the attractions to be found there in the way of views extending over the entire city of New York and the East and North Rivers. Situated 100 feet or more above the street level, the prospect from the different windows is almost unbroken in all directions, and very few of the great structures that have grown up at the lower end of Manhattan Island tower above that in which The Electrical World is situated.

One such "pile stupendous," however, which overtops everything in even this neighborhood, is, of course, the Brooklyn Bridge, a grand structure seen from any point of view or at any time, but especially imposing when viewed from a considerable height and by night. The drawing on our next page shows such a view of the bridge, with its splendid display of electric light, its towering piers, its network of steel lace and its exquisitely proportioned curves.

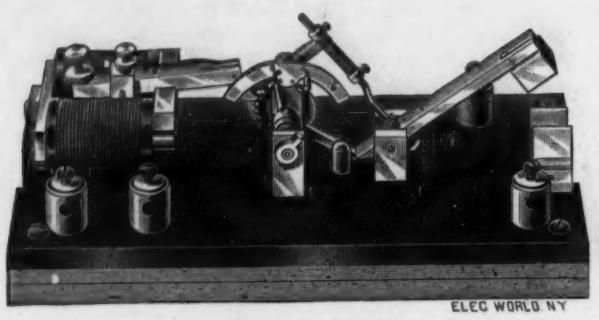
The spectator is just at the level of the roadway at its highest point. Below him—and indeed far below—spread out the roofs of many high buildings; while the huge viaduct itself seems, as it stands out against the black sky, a great streak of brilliancy supported by masses of opaque solidity. Our illustration gives, we think, the best view of the bridge that can be obtained from any part of the city or harbor, and it will please electricians to observe how splendidly the imposing effect of the structure is enhanced by the modern means of illumination.



BROOKLYN BRIDGE BY NIGHT FROM THE OFFICE WINDOWS OF THE ELECTRICAL WORLD.

A Time-Circuit Cut-Out.

The annexed cut represents a very ingenious automatic cut-out for electric-lighting circuits which should prove a useful adjunct to the operation of a great many central stations. One of the troubles incurred in commercial lighting is that part of the customers require lights, say, up to 7 o'clock P. M., another portion till 9 or 10 o'clock, and still others until midnight; and these various patrons are not considerate enough to arrange themselves so that a separate circuit can be conveniently supplied to each class. It is, therefore, frequently a matter of no little difficulty to avoid burning a considerable number of lamps long after the call for them has ceased.



Time-Circuit Cut-Out.

The present appliance is intended to give the central station absolute control over all the lamps supplied by it, and to enable all lamps belonging to one class of service to be shut off at the proper hour and so avoid any current being supplied, for which no pay is received. As will be seen from the cut the apparatus consists of a step-by-step ratchet movement, actuated by a small electro-magnet and controlling spring switch which short-circuits the loop containing the lamps which it is intended to cut out. A small pin inserted at various points in the dial above the ratchet wheel adjusts the apparatus to spring the switch by any desired number of movements of the magnet. The working of the circuit is as follows: A special circuit is used and in it all the cut-outs are inserted in series to each other. This circuit may be of comparatively light wire, No. 14 iron insulated wire answering admirably for the purpose. At the station this circuit is cut into the main line across the terminals of a resistance through which the current can be shunted. The difference of potential between the ends of this resistance is sufficient to throw the desired current around the signal circuit.

Let it be supposed that it is desired to run on the same line 7 o'clock lights, 9 o'clock lights and midnight lights, beside an all-night service. At the entrance to each customer's place of business is placed the cut-out in a closed box, inaccessible to any one not provided with a key. The ratchets of all cut-outs to control 7 o'clock lamps would be adjusted to spring the switch by three impulses of the magnet; all the 9 o'clock lamps would be adjusted to require, say, five impulses, and the midnight lamps seven. All-night lamps would require no cut-out. At 7 o'clock the operator at the central station would open the switch in the loop containing the resistance, and would then press the key in the signal circuit three times, which would cut out all the 7 o'clock lights on the line. At 9 o'clock two additional strokes of the key would cut out the 9 o'clock contingent, and at midnight two more strokes would extinguish everything except the all-night lights. When the lamps are trimmed in the morning the trimmer inserts the key in the box and sets the cut-out ready to be operated at the desired hour.

But a small amount of current is required to operate the signal circuit, and the expense of establishing it is nominal. The apparatus is simple and strongly made, and gives the central station admirable control of all the lights connected with it. Its use would very often obviate inconvenient changes of circuit, and would save no small amount of power in the course of a year's running. The cut-out has just been brought to the front by W. H. Elkins, of Boston, and ought to prove exceedingly useful. Special mention may be made of its service in connection with the series incandescent lamps frequently used on arc circuits. Where this class of lighting is employed it is usual for the central station to assume the responsibility of the lamps, and consequently, if the lamps are burned overtime their life is considerably shortened at the expense of the company. With a cut-out of this sort every one of these can be extinguished at the hour called for in the lighting contract and many days of useful commercial life saved; an economy appreciated by all who supply the electric current.

The Clermont-Ferrand Electric Railway.

This line, which is about four and a half miles long, connects Clermont-Ferrand with Royat-les-Bains. The cars are 40 feet long, and carry 50 passengers; they are worked by 40 h. p. motors, Vaucanson chain gearing being used. The current is supplied at a difference of potential of 300 volts. An overhead conductor run on 26 feet iron posts with rail return is used. This conductor is a slotted copper tube of rectangular section, and is supported by an 8-inch steel cable. The sliding contact is 16 inches long, and consists of a string of bronze balls connected to one another and to the car by a metallic wire. The line is a single one, and passing places are provided at each of the six intermediate stations.

The Vibrationless Running-Gear.

This gear is devised for the purpose of overcoming vibration of a carbody. It is the invention of Samuel J. Block, of No. 1,432 West Harrison street, Chicago.

Vibration arises from gravitation flange friction, from longitudinal thrusts at rail joints, and from the application of the brakes. Irregular vibration is co-ordinate with rigidity, and the proportion of vibration received by the car body is dependent upon how rigidly the body is connected with the gear. Vibration increases with speed; so do wear and tear, and noise and fatigue.

These, in the opinion of Mr. Block, can be got rid of only by a radical change in construction, and the isolation of the carbody from direct contact with the gear. The connection must be indirect and not direct at any point. Then and then only can the gear vibrate without jarring the carbody.

A graduated spring, adapted to the weight to be carried, will not transmit vibration in a vertical direction; so that for vertical or gravity vibration we have this as a remedy. But for lateral, longitudinal or diagonal shocks some other means must be obtained. Simple slack is but a partial remedy, as, for instance, the slipping of the brasses upon the journal; for this has nothing to do with longitudinal vibration caused by thrusts at joints and by flange resistances and the jarring by the breaks.

A high tension placed between body and gear in all directions, is probably the only solution for the trouble. In the device in the accompanying illustration, the wheels, journal boxes and frame or fender are connected rigidly together, forming a running gear which, in vibrating, acts against the inertia of the car body.

The intention is to absorb the force of these shocks, so that they may not reach the car body. This rests upon the gear through the springs. That these are competent to receive the violence of vertical or gravity shocks without imparting the violence to the carbody is axiomatic.

They are utilized in overcoming the shocks from any horizontal or longitudinal direction. There is already a vertical tension in the springs, caused by the weight of the carbody resting upon them. Any horizontal or longitudinal shock is made to increase this tension, to act upon and be absorbed by the springs and be kept from the body.

Hangers are suspended through the springs. Each hanger has a rocker at both ends. These rockers are circular and slightly convex. One rocker *R* rests upon the gear, and one *B* bears upward, supporting the body (pedestal *P*). The body is thus supported upon the gear by hangers and rockers, the springs intervening. It does not rest directly upon the springs, as is usual, but is suspended from them. Any horizontal or longitudinal action of the gear tilts the rockers. This produces a vertical action upon the springs (not a horizontal one). The rockers convert the lateral or longitudinal shocks into vertical ones, which are received by the springs without getting to the car body.

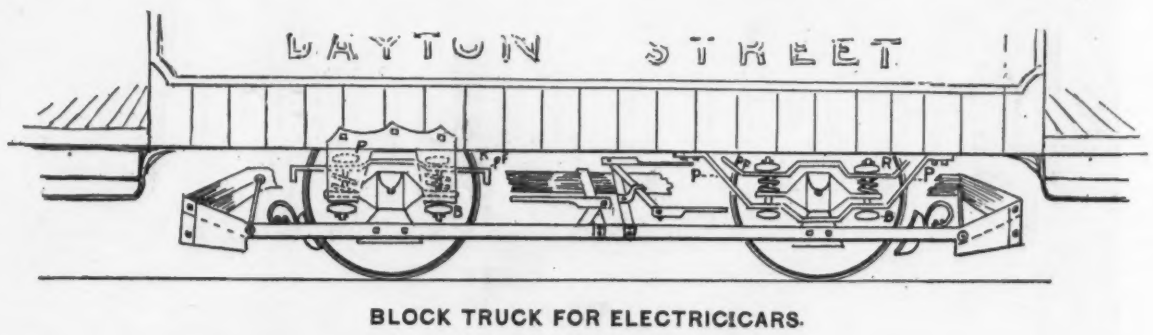
P F is a parallel which secures a united parallel, horizontal action of the rockers upon the springs. One side of the spring is thus not compressed while the other side is released, but the whole resistance of all the springs is obtained at once.

From the fact that the gear is independent in every direction of the car body and that every movement of the gear in any direction whatsoever is made to bear vertically upon the springs (by means of the rockers) the car should ride without rigidity.

The spring having a vertical tension, because of the weight suspended from it, resists these movements with a minimum amount of action, thereby precluding oscillation and substituting therefor a limited high tensional action.

From the fact that the rockers in conjunction with the hangers form powerful levers acting upon the competent and powerful supporting springs, the jars in crossing tracks or in stopping the car quickly or those resulting from the application of the brakes will be kept from the car body.

It is quite feasible, with connections, to pull the car by the gear instead of by the body. The advantage gained in starting easily is obvious.



BLOCK TRUCK FOR ELECTRICICARS.

Magnetization of Steel Cylinders.

An interesting note concerning the effect produced upon cylinders of steel along which strong currents are passed is given in a recent issue of our contemporary, the London *Electrician*. It is said that in 1887 M. Paul Janet showed that cylinders of steel, along which strong currents had been passed, became permanently magnetized transversely. By extending the experiments some very striking results have been recently obtained by M. Decharme, who has described them in the *Comptes Rendus* and *La Lumière Electrique*.

The cylinders used were split longitudinally, and, after the passage of the current, the magnetism of the parts was tested by iron filing figures. It was then evident that not only was the iron magnetized transversely, but the intensity of the magnetization varied in a regular undulatory manner along the bar, the lines of force arranging themselves in somewhat the same way as fine powder in a vibrating tube. The effects could not be accounted for by supposing the iron heterogeneous, because the nodes and loops occurred at about the same distance for different bars of various diameters and lengths. M. Decharme concludes that there is a great difference in the magnetization of an iron core by a steady current passed through a solenoid surrounding it, and that of an iron bar through which a current actually passes. In the latter case, M. Decharme considers that the current is propagated in waves during the very short time necessary to produce the magnetization, and compares the phenomenon with the well known undulatory magnetism produced by the oscillatory discharge of a Leyden jar. The effect is probably due to the starting of the current, and it is therefore unfortunate that no particulars are given of the manner in which this was done—whether switched on suddenly or increased very gradually to its full value. In the latter case, no effect might have been produced, as strong currents were needed to show the phenomenon. The experiments of Blaserna have shown that undulations do actually occur for the first few moments after starting the current, and it is possible that these may be much accentuated when part of the conducting circuit is of iron. The experiments are of interest because they suggest that many phenomena usually attributed to want of homogeneousness in iron may really be due to successively starting and stopping a magnetizing current.

Non-Magnetic Iron.

To the Editor of The Electrical World:

Sir: Is there any such thing as non-magnetic iron, or is there any process by means of which common gray cast-iron may be rendered non-magnetic or its magnetic permeability be very much reduced? Subscriber.

[The addition of manganese will render iron non-magnetic, and alloy containing 12 per cent. of manganese is practically deprived of all its magnetic properties. Alloys of less amount would reduce the permeability to a very great extent. An alloy of iron with 25 per cent. of nickel is also nearly non-magnetic.—Ed. E. W.]

Minute Dynamos.

To the Editor of The Electrical World:

Sir: I am trying to devise a little electrical instrument which I believe will be a convenience, and would like some information from you. Could a dynamo of the circumference of a silver dime and one-eighth of an inch in thickness be made? If so, would it be strong enough to produce sparks of light? J. K.

[It might be possible to construct what would be virtually a dynamo of the size that you mention, but we think that you would hardly get an available spark from it.—Ed. E. W.]

Compasses and Magnets.

To the Editor of The Electrical World:

Sir: Is there such an instrument as a compass that will not be affected by the presence of iron? M. W.

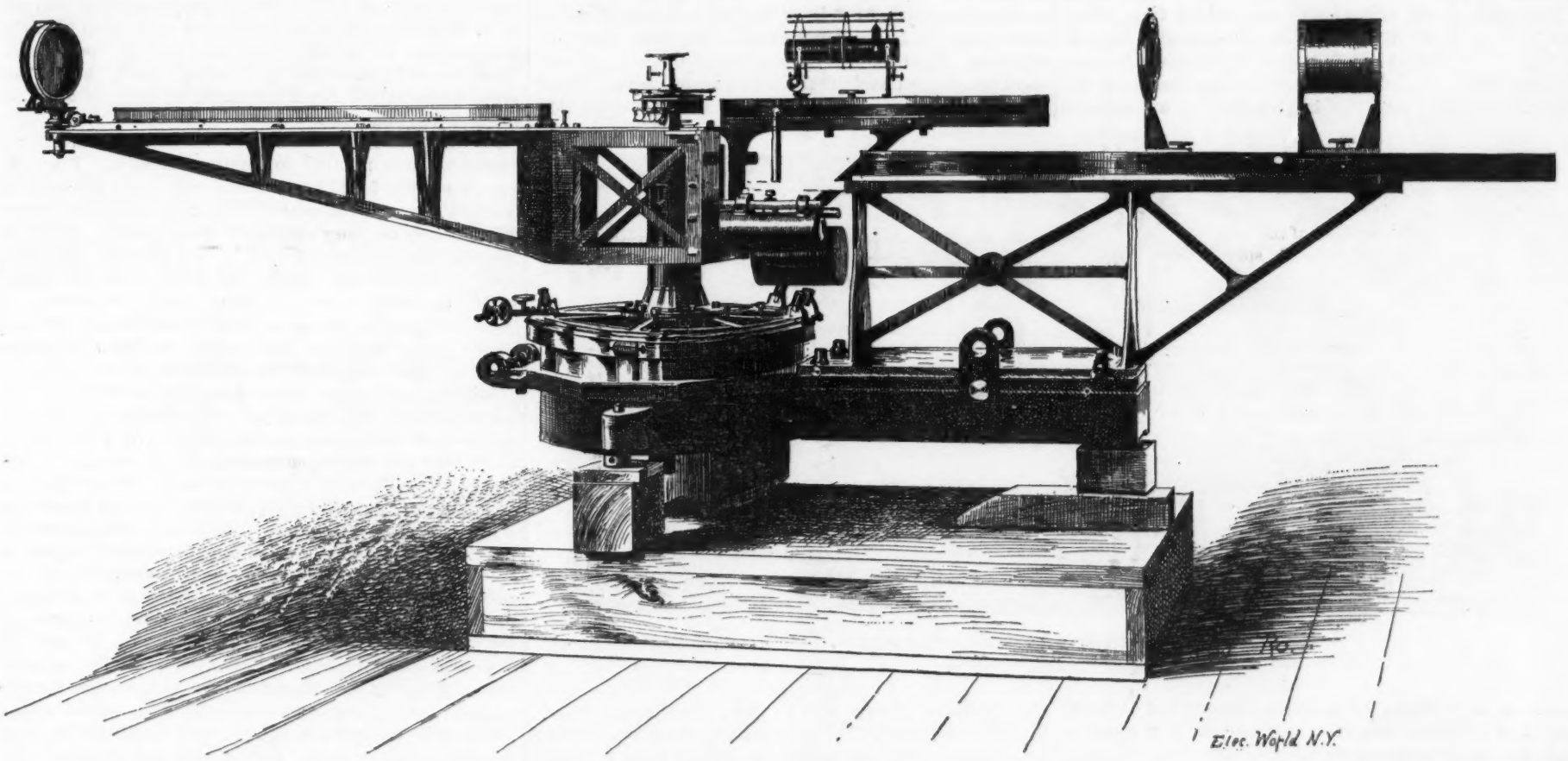
[A magnet is always in some way affected by the presence of iron, and the compass needle is no exception to the rule. The amount of disturbance produced on a compass by iron depends on its position with reference to the needle. In iron ships the effect of the ship's iron on the compass is partially compensated by permanent magnets, but there is always more or less trouble from it.—Ed. E. W.]

The Bolometric Spectrometer.

The difficulties of accurate photometric measurements are well known to practical electricians, but few persons realize how small a part of the total radiation from any given luminous source is composed of light. An incandescent lamp, for instance, pours out an enormous amount of radiant energy which is totally imperceptible to the senses. Most of this is in the form of radiant heat which can be put to no good use. All these invisible heat rays were for a long time a matter of great difficulty. Rough approximations to their amount were obtained by the use of the thermopile, but it was not until Prof. Langley invented that extremely ingenious electrical measuring instrument, the bolometer, that it became possible to investigate in detail the radiation from any given source so as, for example, to determine just what part of the rays that come from an arc lamp are available for light, and in how far their availability can be increased by changes in the apparatus. We illustrate on this page the great bolometric spectrometer, which has just been completed by William Grunow, Jr., of New York city, for the Smithsonian Institute, and with which Prof. Langley will continue his magnificent researches. As will be seen, the instrument has a massive iron bed plate, and rising above it a vertical cast iron axis which is made with tapered bearings to compensate for the wear and weight of two sleeves which rotate upon it, one above the other. The lower one carries the graduated circle, which is 22 inches in diameter and divided on an inlaid silver strip to five minutes of arc. The upper one carries a vernier circle reading to five seconds of arc. These circles are enclosed by a hood for protection, which also serves to carry a tangent screw for adjusting the circles. The upper sleeve on the vertical axis also carries a strong movable arm, carefully counterpoised by the weights seen in the cut. This movable arm carries a graduated track which can be moved in and out from the axis and carefully adjusted to any regular position. On this track, is fitted a slide having supports for the various instruments. At its extreme further end is an adjustable mounting to carry a concave metallic mirror, the purpose of which will be explained later on. One of the slides on this same track carries the bolometer itself, which can be taken off and replaced by an observing telescope of 3½ inches diameter of objective. To the same base plate which carries the vertical axis is built a rigid support for a second graduated track which can be extended if desired. This arm is fitted to carry various pieces of apparatus. The distance from end to end of the two arms when along the same line is no less than 11 feet, and the instrument is undoubtedly the largest of its kind in existence.

To the upper end of the central axis of the instrument are attached a series of adjustable tables for carrying prisms or diffraction gratings of various sizes.

The method of using the instrument as a bolometer is as follows: The radiation, luminous and otherwise, which proceeds from the object to be investigated, is passed through a slit, which is shown in position with its condensing lens on the fixed arm of the bolometer, and then falls upon a prism of rocksalt or upon a diffraction grating placed upon the central table and adjusted to the proper height. Whether grating or prism is used, the result is the same to separate and disperse the various sorts of radiation in precisely the same way that a glass prism disperses a sunbeam into a band of colored light. Rocksalt possesses the property of absorbing little or no heat from the rays that pass through it, while glass, as is well known, shuts off heat to a very considerable extent. We then have the radiation which entered the slit dispersed into a band containing not only light rays of various colors such as will be seen from an ordinary prism, but also the heat rays invisible to the naked eye and the chemical rays which are also invisible. At the extremity of the movable arm of the bolometer is a concave mirror of speculum metal, highly polished, and on this mirror falls the band of which we have just spoken. With the mirror in a certain position, brilliant light will fall upon it. If we swing around the arm to another position, that is, to another part of the dispersed riband of radiant energy, other colors will be reflected from it; and finally we should arrive at a point where the radiation reflected from the mirror would be invisible to the eye, although it might be sensibly hot. The purpose of this concave mirror is to concentrate the radiation which falls upon it on the bolometer itself, which is shown in its case at the other extremity of the movable arm. The bolometer is very simple in principle, depending for its action simply on the fact that the electrical resistance of a metallic wire changes with its temperature. The little flat wire used in the bolometer is not more than the twenty-five-thousandth part of an inch thick, one-one hundred and twenty-fifth of an inch wide, and about three-tenths of an inch long, made usually of platinum, of which, as is well known, the change in resistance with varying temperature is very uniform. This minute strip of metal is in circuit with an exceedingly sensitive galvanometer, and, of course, any change in its resistance will change the current kept flowing through the circuit, and will produce deviations of the galvanometer needle, or rather the spot of light which serves as a needle, the galvanometer being a reflecting one. The radiation from an arc lamp, for example, placed in front of the slit, passes through the prism, is dispersed there, and each portion of the dispersed radiation can be made to fall upon the mirror and be reflected to its focus on the bolometer as the movable arm is changed in position. If the arm should be so placed that yellow light from the arc would fall on the mirror and be focused on the bolometer, there would be a powerful deflection of the galvanometer needle, for the yellow rays are hot. If, however, the arm should then be moved so that the blue rays from the lamp would fall on the bolometer, there would be far less effect on the galvanometer, and the difference in reading on the galvanometer scale would give a correct measure of the relative amounts of energy contained in these two particular colors of light. Still further swinging the movable arm would throw the ultra violet chemical rays to any focus on the bolometer. This would produce a comparatively weak effect. If the arm were swung in the other direction we should have the hot rays falling on the instrument and producing almost as much effect as the yellow ones, and moving it still further along we should get the galvanometer deflections due to the invisible hot rays which pour out from an arc lamp in far greater quantity even than light rays. So by moving the bolometer through a suitable arc, and noting carefully the deflection shown in the galvanometer circuit at each point, it is possible to obtain an exact measure of the distribution of the radiant energy that comes from the arc lamp in front of the slit. When measurements of this kind are taken it is found that only about one-tenth of the energy supplied to the lamp in the form of current appears in the form of useful light. A similar investigation of the incandescent lamp would show the useful efficiency to be only 5 per cent. So it will be seen that the bolometer, complicated as it is, is really an instrument that can be turned to very practical service in the study of possible improvements in our methods of lighting, and researches conducted with it form a valuable addition to the more rapid but less accurate methods that are sometimes used. It is interesting to note that a great part of the sensitiveness of the instrument is due to the fact that the galvanometer is marvelously delicate and will show by a strong deflection a current which in ordinary instruments would be entirely imperceptible. So delicate is it, in fact, that even the rays from the moon and stars falling on the slit of the instrument will sensibly affect the little strip of platinum in the bolometer, and their intensity can thus be measured. Prof. Langley, the inventor of the instrument has spent no little time in thus investigating the radiation that comes to us from the various heavenly bodies.



THE BOLOMETRIC SPECTROMETER OF THE SMITHSONIAN INSTITUTE.

Lightning in Mines.

A remarkable case of lightning is reported by Mr. Hugh R. Muir, of Lonaconing, Md., who suffered a stroke under circumstances that must certainly be considered unusual. Mr. Muir says:

"In the year 1888, while at work in one of the mines of the American Coal Company, at the top of the 'second plane,' I received a shock which is almost indescribable The lightning is supposed to have entered upon the rails and followed them to the top of the first plane, a distance of 2,500 feet from the mouth of the drift; then, following a wire connected with an electric bell used for signaling, came 1,500 feet further, reaching the point where I was at work, having traveled in all 4,000 feet from the mouth of the mine. At the time I was in the act of pulling off the block at the top of the plane to allow the cars to go over, when the shock came upon me with such force that I was dazed and stunned for some time, my entire body becoming perfectly benumbed. A man standing at the top of the first plane was stunned at the same time, as was also a horse. The animal was apparently more affected than either of the men. Since that time I have felt no effects of the shock whatever, and have been able to stand the current of the strongest battery."

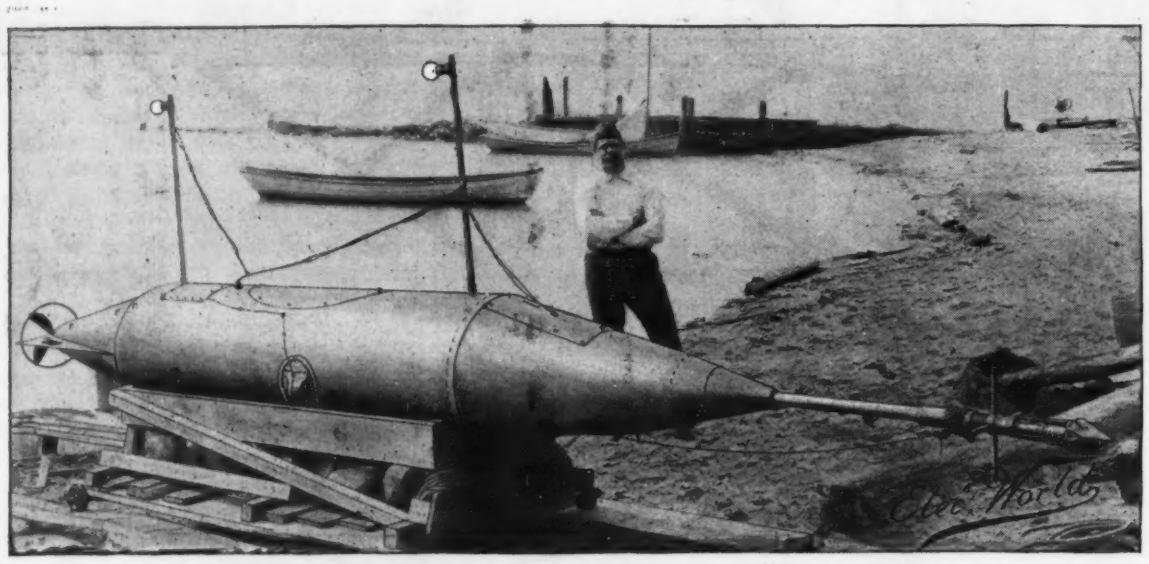
The man who has sense enough to go in when it rains seems to have no advantage over his fellow-mortals when it comes to dodging lightning, if "going in" four thousand feet is of no avail. We should like to have Mr. Muir, in view of his last remark, put in the hands of Dr. Gibier, or some of the English investigators. His experience seems to suggest that lightning acts as a vaccination against electricity. From this point of view why could not some of Kemmler's friends put their client under a modified Pasteur treatment? Here is surely a unique field for inoculation. Of course it would be difficult to apply a regular course of treatment except in the neighborhood of New York in the month of June; but slight obstacles of this kind could without doubt be overcome.

The Halpin-Savage Torpedo-boat.

Considerable interest is being displayed in military circles in the Halpin-Savage automobile torpedo, with which some very interesting experiments were carried out last summer, and which was briefly described in The Electrical World of Oct. 19 last. Considerable improvements have since then been made in the apparatus, and it seems on fair road to develop into an automatic submarine torpedo boat that will prove of no small value in coast defence. It is in fact rather a torpedo boat than an automobile torpedo, and seems capable of doing practically all that can be done by submarine craft of the type of La Gymnote of the French navy, or the Peral boat which has recently attracted so much attention in Spain. It has recently been inspected by General Abbott and the full Board of Naval Engineers with a view to its early adoption for the Government service.

We give below a cut of the original model with which the very successful experiments of last summer were conducted, for the purpose of explaining the mechanism of the craft and showing its remarkable capacity for increased offensive powers. It consists of a cylinder, 23 inches in diameter, terminated at each end by a cone. Its total length from tip to tip of the cones is 12 feet, exclusive of the 4-foot pike which projects from its nose and forms an essential part of the equipment. It is constructed of sheet copper strongly braced internally, weighs about 1,300 pounds when completely ready for service, including the 100 pounds charge of explosive, and sufficient ballast to keep it uniformly upright, floats just below the surface and is guided by projecting staves carrying incandescent lamps.

The motive power of the model was derived from a storage battery of 33 River and Rail cells carried in the rear end of the cylindrical middle body of the boat and furnishing current to a 2 h. p. Perret motor acting directly on the screw. As will be seen, this is protected by an external ring. It is of brass, 12 inches in diameter and 14 inches pitch and the motor can give it if necessary a speed as high as 2,000 revolutions per minute. Just forward of the screw and underneath the rear cone is the balanced rudder. The cable by which the boat is controlled is carried in a reel thrust laterally through the middle of the boat and paying out the wire beneath it. As the wire serves only to carry comparatively small current for steering purposes it is very light, and the full reel in the middle, carrying a mile and a half of wire, weighs only 80 pounds. By means of a very ingenious arrangement of polarized relays this single wire enables the operator on shore to start, stop, back and steer in any direction, and discharge the torpedo.



ELECTRIC AUTOMOBILE TORPEDO-BOAT.

The torpedo proper is quite distinct from the boat, of which it does not form an integral part. A tube passing obliquely downward through the middle body of the torpedo boat holds the torpedo proper, which has in outline the same general shape as the boat. It holds about 100 pounds of dynamite or explosive gelatine and is furnished with independent means of propulsion in the form of a central axial tube loaded with rocket composition which can be discharged electrically at the will of the operator. Projecting from the front of the boat, and in its axis, is a pike about 4 feet long, the front end of which is fitted with permanent projecting arms held forward by a spring. When these permanent arms meet an obstruction when the boat is in motion, as in striking a torpedo net, the spring is compressed and two other arms are released and are thrown outward on the inside of the net. The force of the boat at the same time pressing the staff against the net forces its rear end into the front of the torpedo boat against the resistance of the spring and a hydraulic buffer which are intended to offer such resistance as will be overcome by a strong pressure of the pike. This movement of the pike disengages the three dogs that secure it to the boat. At the same time a dry battery in the nose of the torpedo proper is thrown into action, lighting the rocket composition; the pawl holding the torpedo in the oblique tube before described is attracted and the motor is automatically reversed. The reaction of the burning rocket composition on the water discharges the torpedo from its tube and starts it on a downward path, at the same time igniting the time fuse, so that the explosion takes place only after the torpedo is quite clear of the boat.

Now comes the ingenious part of the operation. The torpedo net has become an essential defence for men-of-war in an enemy's waters, but Lieutenant Halpin has devised a plan for converting this very net to his own uses and employing it to assist in the destruction of the ship it is intended to protect. A chain is attached to the front end of the torpedo and to the pike, the surplus length being coiled loose on the front end of the torpedo boat. As the torpedo itself is discharged this chain is paid out to its full length, and then the pike being firmly fixed in the net the chain snubs up the forward end of the torpedo, compelling it to describe the arc of a circle, thus diving under the net and up against the ship. In the experiments tried the torpedo performed this diving feat very successfully, swinging under a deep net and exploding on the further side. In the meantime the torpedo boat is backing, and continues so to do for 30 seconds, when a clockwork starts the motor ahead again, and the rudder, which in backing is thrown over hard one way or the other, and has caused the boat to turn through a semi-circle, can then be turned by the operator on shore and the boat made to come back to the starting point, ready to receive a new reel of wire, torpedo and pike, when the craft is ready for another attack.

The model attained a speed of about ten miles an hour, and the success of the general plan of operation has encouraged the builder to go on with the designing and construction of a still more formidable boat. The new craft is to be very nearly 30 feet in length, and the cylindrical main body will be about three feet in diameter, of copper, as before. The oblique torpedo tube will be pointed downward at a sharper angle than in the model, as the modern tendency is to construct deeper and deeper torpedo nets. The explosive charge will be more than double that previously mentioned. The reel will contain no less than five miles of wire, and the motive power is to be furnished by an 18 h. p. multipolar Perret motor which is expected to drive the new craft at a speed of about 20 miles an hour. For better protection it is to be immersed five or six feet below the surface, and will carry a light tubular float with projecting staves above the surface of the water. Arrangements will further be made to fit the boat to conduct countermining operations. For this service the torpedoes will be discharged electrically and furnished with time or contact fuses, so that they will only explode when at the bottom or far out of reach of the boat. By this means it will be possible to clear a channel of torpedoes quite effectively, even under fire; for the small projecting portions of the craft, even if struck by the fire of machine guns, would not seriously interfere with its efficiency, and with five miles of cable at command the countermining could be carried on from a point practically out of range. Additional arrangements may be made for throwing torpedoes obliquely upward to explode by contact with the sides or back of the enemy's vessel. In its enlarged and completed form the boat will serve practically the same ends as the submarine torpedo boats designed abroad, but will have the enormous advantage of requiring no crew to be endangered in service. It is really a formidable type of submarine torpedo boat, and its various applications will suggest themselves at once to those familiar with torpedo service; for example, it can readily be fitted to take in tow, below or alongside, a large torpedo of the Whitehead description, to be aimed and discharged when within easy range by the distant operator. Its field of usefulness is not at all dependent on the existence of a torpedo net in the ship attacked, for in a case of there being no net the pike will be detached and float on intact against the ship's side, while under these circumstances the torpedo would be literally keel-hauled and probably explode when in contact with the other side of the ship. It is a particularly interesting application of complicated yet effective electrical methods to the service of modern warfare.

The Thames Electric Launch Fleet.*

The small fleet of electric launches which figured so prominently on the Thames last season will, this year, receive several additions. Hitherto the number of this new type of river boat on the Thames has been about 14; this year there are to be two or three-and-twenty. Of the existing fleet far away the finest is the "Viscountess Bury," owned by Messrs. Immisch. Since she was first brought into prominence some important improvements have been made in this vessel. The first alteration was the addition of a certain amount of "dead-wood" under the stern to assist the steering properties of the launch. She also possesses now a greater length of saloon, and, by sundry other internal rearrangements, her saloon accommodation has been materially enlarged and improved. Over all she measures 70 ft. by 10 ft., and 60 or 70 people can be comfortably carried. She is now worked by a single motor and one 19 in. propeller. When prepared for a trip she is fitted with 164 storage cells. The motor takes on the average 45 ampères and 164 volts. She is steered from the bow end of the upper deck, and, as a rule, runs at about seven miles an hour. The saloon is, of course, amply furnished with glow-lamps, and electric side-lights are provided. The "Ray Mead" is almost twin with the "Viscountess Bury," but is somewhat wider and shorter. The remainder of the present fleet—all owned by and electrically fitted by Messrs. Immisch (or by the syndicate of which they are the visible embodiment)—are much smaller than these two. They average in length from 30 to 40 feet, are worked by single motors with 17½-inch propellers, and are provided with from 30 to 40 storage cells, giving an average current of 27 ampères. They are furnished with such electric lamps as may be necessary, but they are all open boats. Their traveling capacity is, however, pretty much the same as that of the larger launches, and they are much in favor for daylight trips.

The new electric launches that are at present building for the Thames number something like eight. They are almost entirely for private owners, and will in all essential features resemble the smaller boats last described. They will probably be more luxuriously fitted, though they will not otherwise show an advance on the existing launches, but, as the electrical plant will come from the same source they will be equal in that respect. In addition to these new craft there is a small flat-bottomed electric launch being built at Hammersmith for Baron de Rothschild for use on the Dutch canals and on private waters.

Anyone who has traveled on or watched an electric launch gliding through the water can well appreciate the smoothness and quietness of its motion as compared with that of the puffing and rattling of the majority of steam launches, and of the malodorous naphtha launch. With respect to charging stations on the river there is little new to be said. It was expected that some additional shore stations would be erected, but the only one at present finished is that in Platt's Eyot; three others will be shortly equipped. Of the two largest floating stations, one is already at Maidenhead, the other (the "Watt") is now at the Eyot, but later on she will move up to Henley. The rest are, or will be, moored at Reading, Windsor, Staines, and other suitable spots. Kingston is perhaps too near to Hampton for the purpose, but it is suggested that a charging station might very well be moored at that busy and important boating place as a starting point. Seeing how well electricity has answered for launches, the question is raised, why not adapt it to house-boats, which are growing in numbers and in size every season? An electrical plant would be an immense advantage to these floating dwellings, and there would be much saving of steam and horse traction. It only remains for some ingenious mind to make the first experiment and show the way.

The Spokane Falls Electrical Society.

This remarkably enterprising little organization is holding monthly meetings for the study of theoretical electricity, its members being, to a large extent, practical electricians employed in the development of the very great electrical industries that cluster around the splendid water power to be obtained in Spokane Falls. At its last meeting Mr. John Mackenzie read a paper upon magnetism. He began by stating that the whole science of electricity could be conveniently divided into four distinct classifications—first, electricity at rest, or static electricity; second, electricity in motion, or current electricity; third, electricity in vibration, or the range of phenomena formerly coming under the head of light; and, fourth, electricity in rotation, or magnetism. These four divisions he illustrated by analogies, the first being similar to water at rest under very high puressure; the second to the flow of water in pipes; the third to the phenomena of sound and air vibrations, and the fourth to whirlwinds, water-spouts and cyclones. After thoroughly explaining to his hearers the modern theory of magnetism, the lecturer took up the electro-magnetic theory of light, and discussed the investigations and discoveries of James Clerk Maxwell and Professor Hertz. Finally he pointed out the directions in which the present systems of lighting are wasteful, and gave hope of further developments in the direction of economy.

* From *The Electrician*, London.

The Safe Lighting and Heating of Passenger Trains.

An important railway problem is to dispense with the dim and dangerous oil lamps and the deadly heating stove, and in place thereof to supply a system of heating and of lighting that shall contain no element of danger for the passenger in the event of a serious wreck, and yet give perfect satisfaction in a train of from ten to fourteen cars running over lines built through a country noted for its cold waves and long continued range of low temperature at periods during seven months of the year.

Mr. George W. Gibbs, mechanical engineer of the Chicago, Milwaukee and St. Paul Railway Company, has adopted a solution of the problem by constructing an independent "light and heat tender;" in other words a central light, heat and power station on wheels, interior and sectional plans of which are shown on this page.

This special car (Fig. 1) follows immediately behind the locomotive tender, is 34 feet long by 9 feet in width, encased in ¼-inch plate steel, with steel doors, and supported on a platform of unusual strength resting on special trucks. The width of the platforms conforms to the standard, thus reducing to a minimum the danger of telescoping the car following. Including full equipment, the car weighs 65,000 pounds.

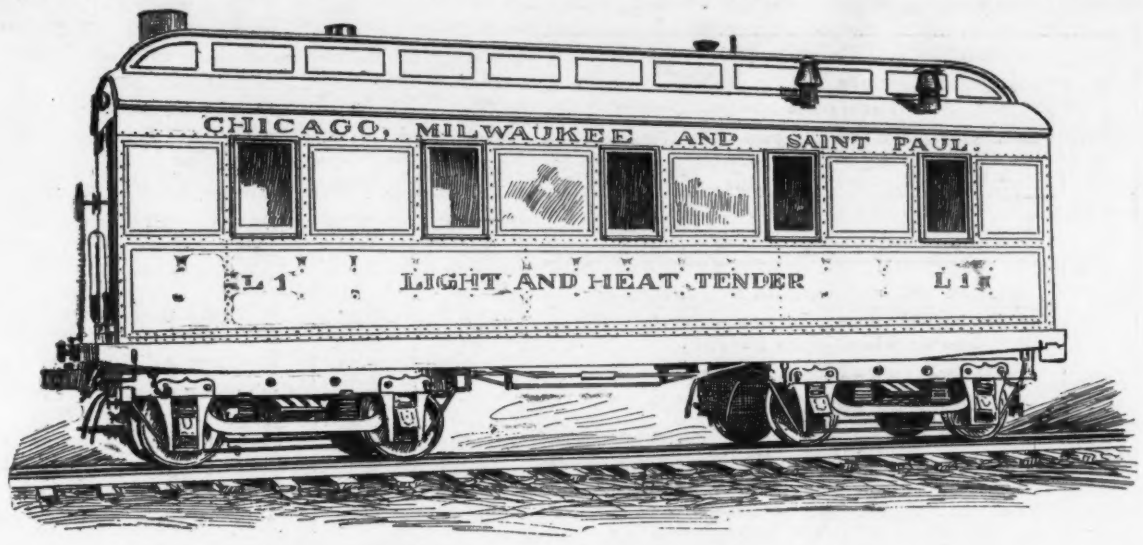


FIG. 1.—GIBBS LIGHT AND HEAT TENDER.

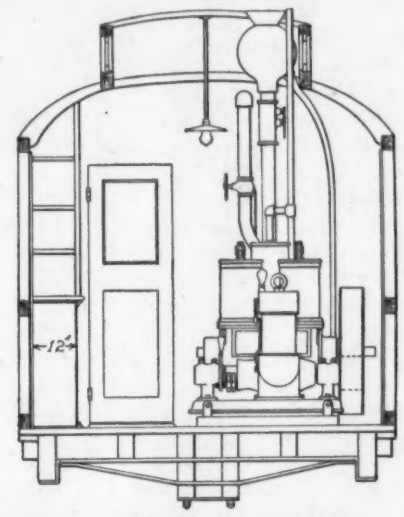
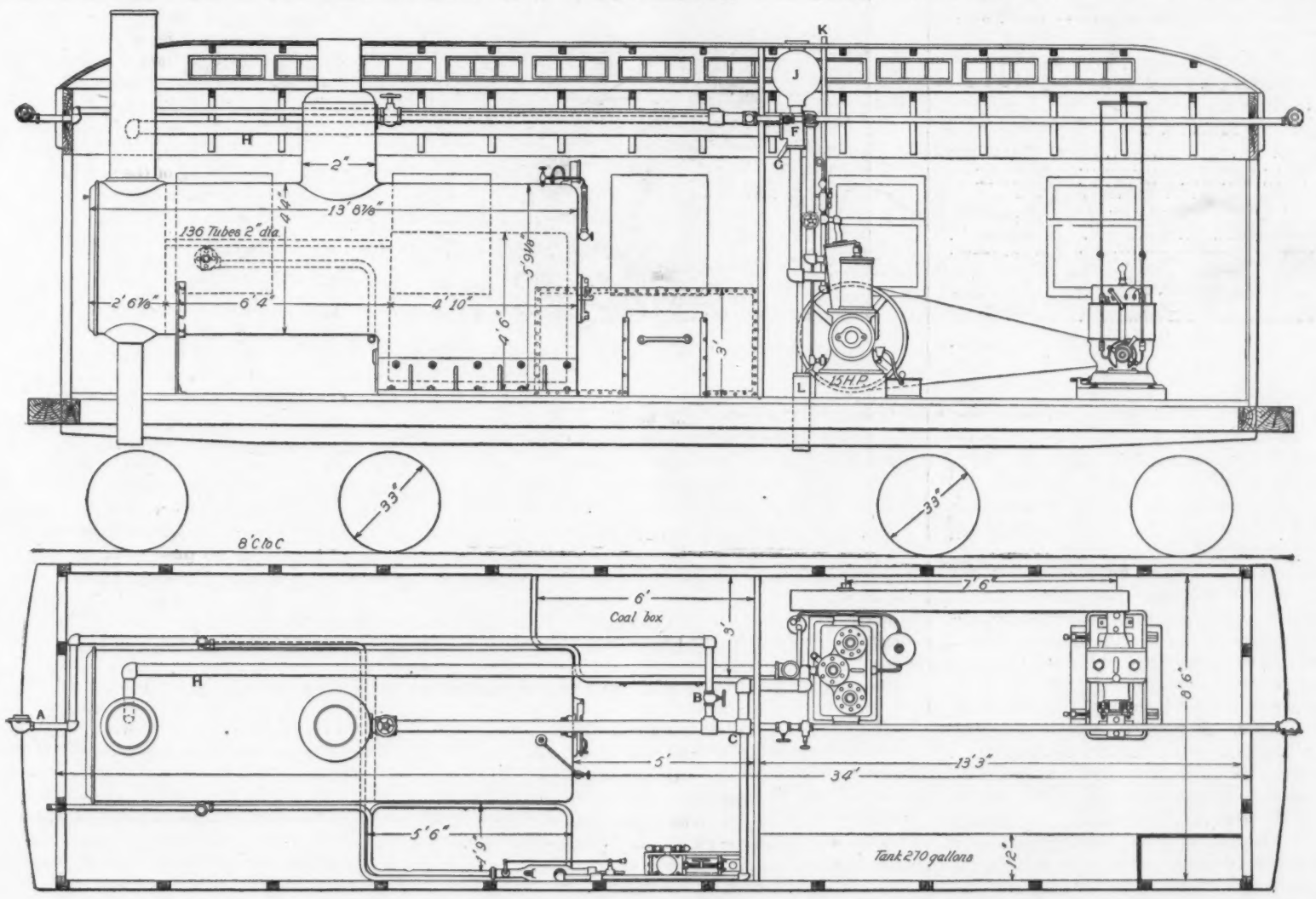


FIG. 2.—SECTION OF TENDER.

The interior of this tender is divided into two compartments, separated from each other by steel doors, the larger or forward section being 20 feet in length and holding a tubular steel boiler of the locomotive type, with water leg around fire-box, designed and built by Mr. Gibbs for this special service, to carry 125 pounds of steam, though but 80 pounds pressure have thus far been used. This boiler is 13 feet 9 inches in length, with 136 two-inch tubes. The furnace is of the locomotive type with safety lock on door, the fire-box being 4 feet 10 inches long and carrying but a thin bed of coals; the ashes being raked down to the road-bed. On each side of the furnace is placed a coal box, the two combined carrying an amount of fuel nearly sufficient for the round trip in mid-winter, thus allowing for any delay not exceeding ten hours. The floor of this section is of iron.

The rear section of this tender (Fig. 2) contains a No. 4 Edison compound-wound dynamo belted direct to a standard Westinghouse engine of 15 h. p., the distance between the centres of shafting being seven feet six inches; the necessary switches, resistance boxes, Weston voltmeter and ammeter, etc., are the same as in a regular station. The weight of engine and dynamo is counterbalanced by a steel tank placed on the opposite side of the section and holding 270 gallons of water in reserve for use in the event of an accident or the absence of the locomotive tender, from which the water required in the boiler is constantly pumped. Experience has shown that when the thermometer falls to 10 degrees Fahr. above zero, it requires 100 pounds of water per car hour to properly heat the train and 70 pounds of water per car hour if the temperature is only five degrees below freezing point. In addition about 58 pounds of water are required per indicated horse-power hour in the operation of the dynamo, thus rendering necessary this extra supply. A double exhaust head permits of turning the exhaust steam into the boiler or exhausting into the atmosphere. Figs. 3 and 4 shows the elevation and floor-plan of the car.



FIGS. 3 AND 4.—GIBBS TENDER—ELEVATION AND FLOOR PLAN.

From the switchboard in the tender, the main circuits of No. 0 Okonite wire are carried along under the roof of the cars in four lengths; No. 1, the positive wire of lamp circiut, being placed on left hand side; No. 2, the through wire of loop; No. 3, the negative lamp circuit wire and return of loop; No. 4 being held in reserve for special purposes.

In wiring the Pullman sleepers for this system, the following rule is generally observed: Two hundred and eighty feet of No. 0 Okonite wire is used as main circuits. From No. 1 and No. 3 run 15 feet of No. 4 insulated wire to switch-box and from thence 240 feet of No. 9 wire carry the current to the fixture or lamp circuits, composed of 210 feet of No. 16 insulated wire and 25 feet of flexible duplex cord. The lamps on these circuits are arranged one on each side of the ten chandeliers in the middle of car, then there is a lamp above each outer entrance to car and in each passageway as well as in the toilet rooms, making a total of 27 lamps. An independent circuit, leading from switchboard, of 140 feet of No. 12 wire, carries the current for the six Gibbs' berth lamps. These berth lamps were illustrated in the issue of THE ELECTRICAL WORLD of Feb. 8, the lamp being placed within a drum having two rotating shutters, which can be raised or lowered when desired to use or to shut out the light. The hood, formed by the upper half of the drum, is so arranged that it shades the light from the eyes of the passengers who are facing it, and it also serves as a reflector to cast light upon the book or paper in the hands of the passengers sitting under it. As the shutters open on both sides, one lamp does for two berths, and the closing of the second shutter, when the occupant is through using the lamp, cuts it out of circuit. Should occasion arise during the night to use the lamp, the simple opening of either shutter cuts the lamp in circuit.

For supporting these wires 75 feet of molding for four wires and 202 feet for two wires are required. The switches, plugs, cut-outs and sockets used are of Bergman's standard make and interchangeable. From 154 to 160 16-c. p. 103 volt lamps are in operation throughout the entire train, distributed as follows: Baggage, 61; mail, 12; passenger, 11; sleeper, 33; dining, 17; parlor, 16.

The method of operation is very simple and similar to that presented in a central station. Take the St. Paul trains for instance. On that division this special tender is attached to trains Nos. 1 and 4. Train No. 1 leaves Chicago at 5:30 P. M., makes 20 regular stops and arrives at

its destination, Minneapolis, 420 miles distant, at 7:40 the next morning. On starting out the train consists of a locomotive and tender, the Gibbs light and heat tender, a mail car, baggage car, three ordinary coaches, two Pullman sleepers, a dining car and a parlor car. At Milwaukee the two latter are dropped and a Pullman sleeper added, thus making nine cars for the 365 miles run. On returning, No. 4 drops the sleeper at Milwaukee and picks up the dining car and the parlor car.

To take care of boiler, engine, dynamo and lamps, in fact the entire service of the St. Paul section, but four men are required, and are detailed for service as follows: Man No. 1 makes the run from Chicago to Minneapolis and return, securing all the sleep possible during the day's lay over at Minneapolis. Man No. 2 then makes the round trip, thus allowing number one a lay over of 36 hours in which to rest and recuperate.

When the train is being made up in the yards steam is gotten under way in the tender, and the Westinghouse engine and Edison dynamo started, the lamps turned on as being required till 11 P. M., when all are turned out save those on the end circuits in the vestibules, toilet rooms and passage ways, and about 6 A. M., the necessary lights are turned on again, but the dynamo is continually in operation during the entire night.

When this system was first placed in operation it was deemed best to carry a set of storage cells to be kept charged for use should the engine or dynamo break down, but after several months' service had demonstrated the practicability and success of the system, it was deemed an unnecessary expense to haul the weighty storage cells over the road, and thus they were taken out. Again, lighting direct from a dynamo enables a current of higher potential to be used.

The system thus worked out, and which has been in successful operation for nearly two years, is not only original in many of its details, but is a radical departure in many respects from the methods heretofore pursued, and in considering the economy of this system over that employed on other railways we must not forget that this is a combined heat, light and power plant; that there are no storage cells used, and what is far more important, the climate is an extremely cold one. It is worthy of note in this connection that the first car was run out sixty days after instructions had been received to devise some method of lighting and heating a train that would insure perfect safety to the traveler.

An idea of the efficiency of the system may be drawn from the following tables, 1, 2 and 3, showing the results of a recent test:

TABLE NO. I.

Current used per trip	48,000 watt hours.
Maximum lamp load	152 lamps.
Running time	11 hours.
Electrical horse power hours	59.4
Mechanical horse power hours	68
Indicated horse power hours	85.6
Water per horse power hour	57.8 pounds.
Water per trip for light	4,948 pounds.

TABLE NO. 2.

Indicator, Test Engine No. 2.

Card No.	Ind. H. P.	Mech. H. P.	Differences.	Difference allowing for friction	Lamps burning.	Lamps per ind. H. P.	Lamps per mech. H. P.
5	11.6	9.15	2 45	+ 05	142	12.2	15.5
6	10.16	8.16	2.	—.04	122	12.	14.9
8	9.43	7 63	1 8	—.6	112	11.8	14.6
11	7.13	5.53	1.9	—.5	78	10.5	14.1
13	5.6	3.1	2.5	+.1	34	6.1	11.
15	4.44	1.84	2.6	+.2	26	5.9	14·1
17	11.13	9.23	1.9	—.5	142	12.7	15.3
22	11.71	9.41	2.3	—.1	142	12 1	15.1

TABLE NO. 3.

Indicator Test of Engine in Light and Heat Tender "L 2."

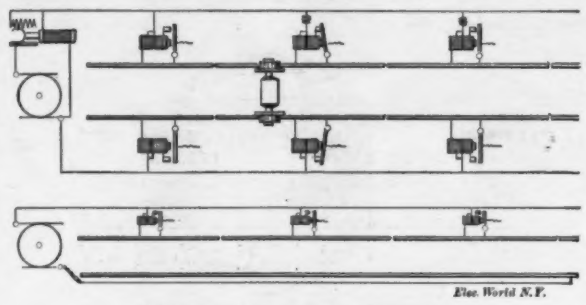
Card No.	Boiler Pressure.	Initial Pressure.	M. E. P.	I. H. P.	Revolutions.	Volts.	Ampères.	Watts.	Elec. H. P.	Mech. H. P.	Lamps.
5	67	54	29.5	11.6	391	99	60	5940	7.96	9.15	142
6	72	59	27	10.16	391	100	53	5300	7.10	8.16	122
8	78	67	24	9.43	391	100	49.5	4950	6.64	7.64	112
11	85	70	18.7	7.43	395	100	36	3600	4.82	5.54	78
13	80	72	13.9	5.6	400	100	20	2000	2.68	3.08	34
15	76	63	11	4 44	402	100	12	1200	1.61	1.85	26
19	80	71	6.6	2 6	400	Fields excited only.					0
20	80	75	5.1	2.39	400	Friction card.					0
17	65	53	28.3	11.13	391	100	60	6000	8.04	9.23	142
22	100	88	29.8	11.71	391	100	61	6100	8.18	9 41	142

During the few summer months, when the heating of the trains is unnecessary, the light and heat tender is laid aside, and the same dynamo and engine placed in the center of one end of the baggage car, the combined equipment occupying about 12 feet of space for the storage of baggage. The locomotive boiler supplies the necessary steam to the Westinghouse engine.

In this connection it will also be proper to refer to the use on these trains of the electric temperature regulators, by means of which the temperature of each car is always automatically maintained at a certain degree, thus adding much to the convenience of the passengers. Mr. Gibbs has certainly presented a very effective and admirable substitute for those twin bug-bears of modern railway travel, the car-stove and the oil-lamp.

Hunter's Electric Railway System.

Just now there seems to be special activity of inventors in the branch of electric railway work specially fitted for city traction. The many difficulties of an underground conduit source of supply have compelled the adoption of compromise methods. Of these the one illustrated herewith, recently patented by Mr. Hunter, is an excellent specimen. The fundamental idea of all devices of this kind is to use working conductors which are not kept continually charged by the source of supply but are only connected with it during the time that the car is on any given section. This enables the rails to be utilized as conductors without a severe amount of leakage under ordinary circumstances, for the length of rail charged at any one time is so short that the insulation resistance of the system is reasonably high. At the same time there is little danger of shocks from the charged conductors, inasmuch as the sections through which the current is flowing may be placed practically under the car.



Electric Railway System.

As will be seen from the illustration, Mr. Hunter proposes to use electro-magnetic switches to throw the current on two successive sections of the line. It is obvious that under this arrangement the supply conductors can be carried underground or overhead, or in any convenient situation. This is one of several similiar inventions which have appeared recently, and it is to be hoped that ere long it will be given a practical trial, for in some cities overhead service is quite impracticable, and the successful use of any one of the sectional conductor systems would go far toward extending the general use of electric traction in the place where it is most needed. It is obvious that the general method of construction employed by Mr. Hunter applies equally well to sectional conductors formed by the track or placed in the conduit underneath it. In this latter case the insulation of the working conductor, enormously difficult in ordinary conduit systems, becomes comparatively simple.

Telpher Lines.

The new telpher line at East Pool, Cornwall, will be opened shortly. This line is to be used for the carriage of minerals. It is about 1¼ miles long, double track. The line is entirely automatic, the motors being arranged to take the current required. Some of the inclines being very steep, automatic centrifugal brakes are applied to keep the speed regular and prevent the cars from running away. No attendant or driver is required, the cars maintaining the requisite speed throughout the length, and stopping or starting at the turning on of the switch. A passenger telpher line of ¼ mile length has been erected at the Edinburgh Exhibition. The line is run on overhead wires on posts; it is a curved line, not rigid, and will therefore provide some of the amusing elements of a switchback. These trains also will be without drivers and automatic in regulation.

The Cardew Voltmeter.

Professor H. F. Weber, of Zürich, has been testing some Cardew voltmeters. His report upon them is as follows:

In the laboratories for alternating current work of the electro-technical part in the new Physical Institute of the Federal Polytechnical School at Zürich, I use 12 Cardew voltmeters of MM. Paterson and Cooper to measure potential differences between 20 and 1,250 volts.

After receiving these 12 voltmeters I have made very numerous and exact measurements to get the differences between the indications of these voltmeters and the true values of the potential differences.

The results of all these measurements were very satisfying, as will be seen from the following comparison:

Voltmeter, No. 612.		Voltmeter, No. 613.		Voltmeter, No. 614.	
Value.	Indication	Value.	Indication	Value.	Indication
Volts.	Volts.	Volts.	Volts.	Volts.	Volts.
24.15	24.23	24.15	24.07	64.50	65.00
28.17	28.47	28.07	28.13	70.81	71.30
35.92	36.42	35.92	36.28	78.81	79.41
44.02	44.40	44.12	44.50	82.96	83.40
52.17	52.57	52.17	52.70	87 01	87.71
60.35	61.00	56.17	56.77	91.20	91.60
64.86	64 46	60.35	60.97	99.40	99.70
69.29	69.00	69.29	69.28	107.61	107 71
77.09	77.00	77.09	77.46	111.72	111.90
85.40	84.80	85.40	85.34	115.72	115.81
93.75	93.20	93.75	93.43	119.70	119.70
101.88	101.24	101.88	101.80	.....	.....
110.10	109.48	110.10	110.35	.....	.....
122 10	122.19	122.10	122.39	.....	.....

The Utica Belt Line Railway, Utica, N. Y.

The Utica Belt Line Railway, which is herewith illustrated, has recently been put in operation under the Thomson-Houston electric railway system, and is a fine piece of construction which embraces more than a few conditions not found in ordinary electric railway construction work. The total length of the track is 20.37 miles, 15.84 miles single and 2.27 miles double track. Seven and eight-tenths miles of single track is located near the curb line, on which the single bracket suspension is used; on the remaining track cross suspension is employed with occasional exceptions. There are 32 turn-outs aggregating 6,200 ft. in length, 18 single and one double track curve, and eight steam railroad crossings. The maximum gradient is eight per cent., and occurs at a distance of about 1,500 feet from the power station, and extends a distance of about 300 feet. There is one curve with a 50 foot radius, which has a grade of 5 per cent.

ELECTRIC ROAD AT UTICA, NEW YORK.

The power station is a handsome one-story brick building, equipped with all modern conveniences and necessary minor apparatus for a first-class power plant. It is well-built, finely lighted, and the arrangement of the apparatus is admirable. At present three 200 h. p. Armington & Sims compound condensing engines are in place, and a battery of four boilers for supplying the necessary steam. The station is admirably situated as far as coal and water supply is concerned, the water being obtained from a large canal on one side, while the coal is dumped from the steam railroad cars on the other side directly into the boiler room. Six 80 h. p. Thomson-Houston railway generators are now in daily use.

The car equipment consists of 25 cars, each having two 15-h. p. Thomson-Houston motors. The power station, and in fact the entire installation, reflects great credit upon the railway company, which from the start had a disposition to use only the best material and forms of construction. The successful operation of the road since its start has shown this to have been a wise plan.

The Johnston Electric Train Signal.

It has long seemed very desirable to railway officials to secure a more satisfactory means of communication between the conductor and engineer than is afforded by the ordinary bell rope. The ability to signal from end to end of a moving train with ease and certainty is certainly an important factor of safe running, and we illustrate this week a system which, in the experiments tried with it, has met with very gratifying success. It has been recently brought to public notice by the Johnston Electric Train Signal Company, of Boston. It is a very ingenious contrivance, simple in the end, and yet showing considerable thought in its gradual development.

By its use perfect communication can be kept up with any part of the train at any given instant. The device represents a really continuous wire, and is in no wise an involved affair. In the first place, a thoroughly insulated series of wires, woven into one cable, similar in size to the ordinary bell-cord, and covered with a serviceable material, is suspended through the centre of the car, while at intervals of a dozen feet or more this cable is tapped and a push-button introduced, which forms a juncture or electric contact. This button is globular in shape and is covered with rubber, thereby making it impossible for any dirt or moisture to accumulate beneath its surface, and insuring a perfect friction between the points of contact which

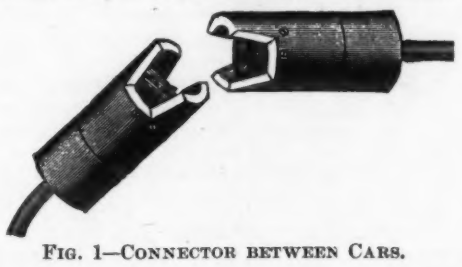


FIG. 1.—CONNECTOR BETWEEN CARS.

embrace the cable. Indeed, the continued use of the button polishes and brightens the non-corrosive bronze points or surfaces, which action keeps the current free and prevents interference with the objects of the signal.

Being placed at convenient intervals in the car and on the platforms, this button can be pressed by the conductor, and simultaneous with the pressure, as if he had touched a valve in the cab, the whistle sounds, which is an acknowlment from the engineer that the electric current has set the bell over his head vibrating, and that he heard the exact number of signals—a feature utterly impossible with the old bell-rope and gong.

The cable exposed to the weather and friction is protected with rubber tubing, and this is clamped in such a way that if any one should attempt to pull the cable from the inside it could not be dislodged. As previously hinted, the coupler, when applied to any train, freight especially, if disconnected, will cause the bell to be rung continuously both in the engine and the caboose, which would generally signify that the train had parted or some rupture had taken place. Thus it is that the cable is either a continuous one or that it has exercised its powers from cause, a fact which is of vast importance and which readily

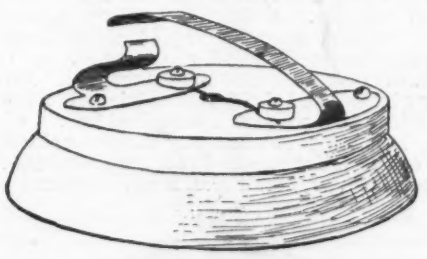


FIG. 2.—PUSH BUTTON—INTERIOR.

recommends itself to the attention of railroad men throughout the country.

By its use the conductor informs his engineer, in an instant, that something is wanted, and simultaneous with the pressing of the electric button comes a reply from the engineer. It would be difficult to enter into the ramification of a conductor's duties, but he has many wants which the engineer alone can supply. He wants more or less steam; he desires to speed the train or slack up, or go ahead, slow; he may require an instant stop, or a halt at the next station, or a reversal of the train; here are only eight requirements among the many, but the ordinary bell-rope gong will not carry a code of signals of this capacity; even if it did, the engineer is likely enough not to get the whole number of strokes, or the cord may break, or, owing to friction, if the cord is pulled several cars back he may not be alarmed at all. On freight trains the need of signals between the conductor or brakeman and engineer is equally as great, and, judging from the numerous "smash-ups" of late years, the community may well be distressed at the condition of things. As now arranged a train may break and the engineer not know it until the derelict has been wrecked or violently sided against a freight-house or passenger train, demolishing everything in its course, as well as exterminating the unconscious men in the caboose.

An important factor of the system is the coupler between cars shown in Fig. 1. It is strong and carefully made, so that there is little likelihood of the contacts being injured by moisture or dust. When the coupler is pulled apart the circuit is closed automatically, causing a bell to ring in the engine. This enables the engineer to know immediatel the occurrence of such an accident and perhaps to avert injury from the uncoupling of the car. Long continued ringing the bell in the car will mean distinctly enough that such an uncoupling has occurred or that the signal is in some other way failing to perform its usual functions. The push button (Fig. 2) was arranged with especial reference to keeping the contacts clean, which is accomplished by making both contact springs, the one a long one and the other a short one, so that on pressure there is a scraping contact, that is sure to keep the surface clean and bright.

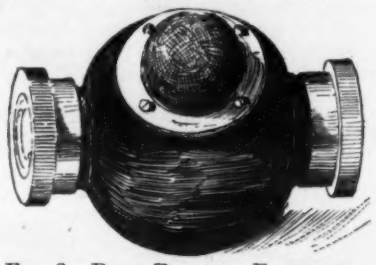


FIG. 3.—PUSH BUTTON—EXTERIOR.

Fig. 3 shows the push-button as coupled up in the cars for the use of the conductor. It is available in numerous points to throw out the train, and enables the conductor to have as complete a communication with the engineer from any part of the train as if he were within calling distance. The push-buttons are arranged along the wire line in the place usually occupied by the bell-rope, as shown in Fig. 4, which gives an admirable idea of the advantages of the system.

FIG. 4.—JOHNSTON ELECTRIC TRAIN SIGNAL.

Cooking by Electricity.

Dr. W. Leigh Burton, Superintendent of the Burton Electric Company, of Richmond, Va., was recently asked to give his views upon the feasibility of economical cooking by electricity. Dr. Burton states that he has lately made a number of tests in this direction with the Burton electric heater. He found that with the use of 9 ampères of current coffee could be boiled and meats roasted or fried as nicely as on a kitchen range, and that after the water had been brought to a boil with the use of 9 ampères, the boiling could be continued almost indefinitely with the use of one-half this current, say 5 ampères. The cost of cooking by electricity depends evidently upon the cost of the current used, and it is not believed that at the present time this method of cooking would be economical except where special circumstances rendered the current needed easily and cheaply obtained; as, for instance, where water power is available or the necessary power exists for other purposes in the building. If one and the same company undertook the introduction of electric cooking stoves, and also the furnishing of current, they might make the method fairly economical by supplying the current at moderate rates; adopting the policy pursued by some gas companies at the present time.

The electric stove unquestionably outlasts the ordinary kitchen range. At the St. Louis exposition last Fall one cooking Burton heater using 9 ampères of current, and on which water was kept boiling for over a month, required during that time nothing but the splicing of the resistance wire on the inside, an operation which occupied but a few minutes of time and occasioned an expenditure of only a few cents in money.

Dr. Burton believes that no one form of electric heater is in any great degree more efficient in the conversion of electricity into heat, than any other form, and cites in this connection the report of the Committee on Science and the Arts, of the Franklin Institute. This committee in its report on the Burton electric heater says:

"It is well known that a unit of electrical energy, when converted, will develop a certain definite and well-known quantity of heat, independent of how it is converted, provided there is no induction, counter electromotive force, leakage, or electrolytic action, conditions which are easily fulfilled in many ways. In such cases, therefore, the cost of the electrical power actually consumed will be the same for all electrical heaters for heating the surrounding air. Your committee, therefore, need not consider this point nor the actual cost of heating air electrically, as that must evidently be the same for all good electrical heaters."

This committee further reports: "Whenever the expense of the electrical energy on the premises warrants it, your committee is of the opinion that electrical heating has very great advantages in almost every feature over all other known and practical means of heating."

An Automatic Wire Calculator.

One of the most important problems engrossing the everyday attention of the practical wireman is the proportioning of the size of the wire necessary to be used both in the interior of buildings and outside, to carry safely and economically the amount of current requisite for a given number of incandescent lamps.

Most of the wire houses have issued a chart of some character to help the wireman in this difficult part of his vocation, but the charts for the most part are large and cumbersome, cannot be readily handled, and fail to fill completely the wants in this direction.

In order to meet the demand for an automatic wire calculator, one that can be readily carried in a small space in

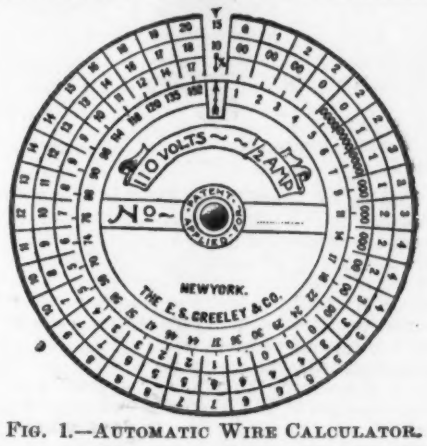


FIG. 1.—AUTOMATIC WIRE CALCULATOR.

the pocket, handled quickly and conveniently in any position, and one which will make an infallible calculation, The E. S. Greeley & Company, of New York, have issued the device here shown, which consists of two discs of stiff cardboard of unequal size, the smaller one being mounted in the centre of the larger and made to revolve thereon. On the back of the larger cardboard are full directions for the use of this unique and useful tool. The present cards are arranged for the calculation of wire for a current of 110 volts, and we understand that there is also another one in preparation arranged for 55 volts.

The process of calculation is shown in the illustrations, Fig. 1 showing the two discs in their normal position and

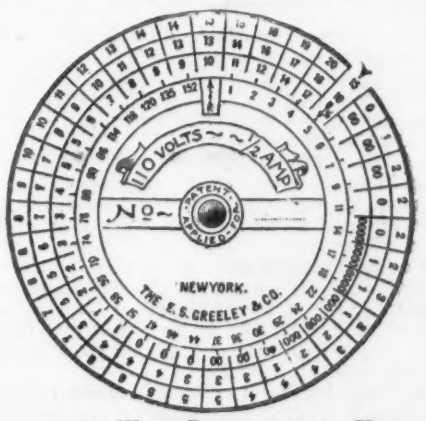


FIG. 2.—WIRE CALCULATOR IN USE.

Fig. 2 showing the calculation determining the size of wire suitable for use to carry a current 5,000 lamp feet. The lamp feet are obtained by multiplying the foot distance by the number of lamps, that is, 50 lamps at 100 feet, or 10 lamps at 500 feet, or 500 lamps at 10 feet, when multiplied one with the other give 5,000 lamp feet. It is then only necessary to turn the inside dial until the figure 5 on the scale of the inside disc comes opposite the arrow which is upon the outside disc, which operation is shown in Fig. 2 of our illustrations. When this has been done the arrow upon the inside disc will point to the size of wire which it is desirable to use and which in the accompanying illustration is shown to be No. 10 for a 5 per cent. drop, No. 13 for a 10 per cent. drop and No. 14 for a 15 per cent. drop.

This ready and accurate calculator seems to us to be of great use to the practical wireman.

Steering by Electricity.

An officer on board the German ironclad "Preussen" has, in conjunction with the engineer of that ship, invented an electrical steering apparatus, about which there is much talk just now in naval circles. By means of this apparatus the captain can control the rudder from the bridge or from any point on the deck—a great advantage in the noise of a storm or in action. The government considers the invention highly important.

n Prof. Elihu Thomson's Electro-Magnetic Induction Experiments.

BY J. A. FLEMING, M. A., D. SC., M.I.E.E.

(*Continued from page* 406.)

One of the most beautiful of Professor Thomson's experiments illustrating this repulsion can, I think, be shown to you now.

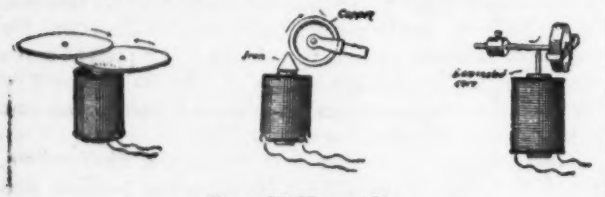
An incandescent lamp is attached to the terminals of a coil of wire, and the coil and lamp floated in water or hung from a scale beam (Fig 24) over the pole of an alternating magnet. The coil and lamp form as it were a balloon

Fig. 24.

and car floating in space, and placed in a magnetic field. When that magnetic field is rapidly alternated by exciting the magnet, the induced currents created in the coil make themselves evident by illuminating the lamp, and the repulsive electro-dynamic action shows itself by lifting the lamp and coil upward through the water or the air.

The same experiment renders it possible to show the effect of magnetic screening very prettily. If I introduce a plate of copper between the magnet pole and the induction coil attached to the lamp, the copper "screens" the coil from the inductive action of the pole, and the light of the lamp disappears. I must next direct your attention to some curious effects which are found to exist when two conducting circuits are exposed to the magnetic flux from an alternating magnetic pole, and which depend upon the interaction of the currents induced in each respectively. Prof. Thomson embodies these facts now to be considered in four laws, which may be briefly stated as follows:

1. If two or more closed circuits are similarly affected



Figs. 25, 27 and 28.

inductively by an alternating magnetic field they will attract one another, and tend to move into parallelism.

2. Iron or steel masses placed in an alternating field give rise to shifting magnetism or lines of force moving laterally ; and may, therefore, act to move closed circuits in the path of such shifting lines.

3. Closed circuits in alternating magnetic fields or fields of varying intensity give rise to shifting magnetism, or lines of force moving laterally to their own direction, and may, therefore, act to move other closed circuits in the path of such lines.

4. Iron or steel masses may, when placed in an alternating magnetic field, interact with other such masses or with closed electric circuits, so as to produce movement of such masses or circuits relatively, or give rise to tendencies to so move, the effects depending on continual adaptations of shifting magnetism relatively.

It is a simple matter to illustrate these principles, and the experiments which are designed so to do bring before us some striking peculiarities of the action of magnetic

Fig. 26.

force upon closed circuits and upon masses of conducting and magnetizable matter.

Returning, first, to the simple experiment of a copper ring repelled by an alternating pole, we find that if we add a second ring under the first they both attract one another, and the two rings are supported and repelled as if they were one ring. It is obvious that at any instant the induced currents in both rings are in the same direction, and hence they attract one another.

Such an attractive action can be made to produce continuous rotation. We have only to place a copper ring or plate over the alternating current coil or pole, and then bring a copper disc, free to revolve on pivots, into proper position relatively thereto. This can best be done by placing the ring or plate so as to be somewhat to one side of the pole, so as to "shade" part of it, as it were, while a part of the pivoted disc is placed under or over it, in front of the alternating pole. The disc then begins to revolve rapidly on its pivot (Fig. 25). A little consideration shows that in this case the fixed copper plate shields a portion of the pivoted plate. The currents induced in the fixed plate attract the non-symmetrically placed induced currents in the other disc and set up a tangential action or couple upon it, tending to pull it round. The continual repetition of this action as each portion of the plate becomes in turn the seat of maximum inductive action, results in a continual revolution of the plate. Two pivoted discs may be used instead of one, and it will be found that they may each "shade" a portion of the pole, and, if made to overlap, they will pull each other round and revolve in opposite directions when the alternating pole acts upon them.

This principle of "shading" a portion of the magnetic pole, and hence causing an unsymmetrical distribution of induced currents in a conducting body capable of revolution on a pivot, has been developed by Professor Thomson in many extraordinary ways.

Floating, for instance, a hollow sphere of copper on the surface of water in a glass vessel, he places this over an

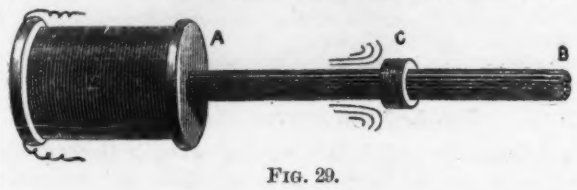


Fig. 29.

alternating magnetic pole. If the pole is placed directly under the sphere, the electro-magnetic action would, as before explained, result in a repulsive force acting upon the disc. If, however, a sheet of copper is placed half over the pole so as to "shade" a portion of the copper sphere, the currents induced in it are unsymmetrically situated with respect to its centre, and react upon the current induced in the plate. Hence, the electro-magnetic action resolves itself into a torque or couple, causing the ball to spin rapidly upon its centre, and take up a rapid rotation. So considerable is the rotational force brought to bear that the ball will rotate when merely laid on a sheet of copper, even overcoming the friction of such rotation on its equatorial line,

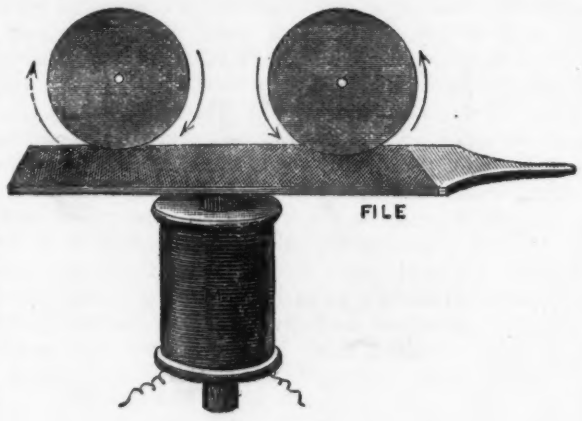
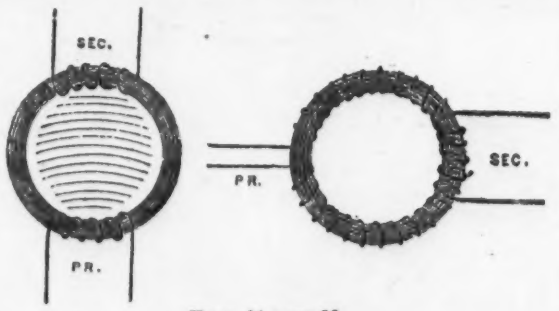


Fig. 30.

provided that the ball and supporting plates are so held over an alternating pole that the plate shields a portion of the sphere (Fig. 26). Given this principle that by properly "shading" a pole from a portion of a solid body capable of revolution round a line or axis, it is easy to see that countless forms of electromotor can be designed.

A sort of anemometer with copper discs for cups resembling the cross of a Crookes' radiometer can be set in rapid rotation by an alternating pole, if a copper screen be placed so as to shade one side of it.

This unsymmetrical development of the induced currents can be produced by a suitable disposition of the magnetic pole alone. Thus we may place a cone or wedge of iron on the alternating pole, and hold near it a copper ring mounted so as to be able to revolve (Fig. 27). The copper cylinder or wheel revolves rapidly under the action



Figs. 31 and 32.

of the periodic field, and its direction of motion is such that it seems to be blown around by a blast from the end of the magnetic cone. Prof. Thomson has constructed a curious electrical gyroscope as follows: A vertical pivot projects from the center of an alternating pole (Fig. 28), upon which is pivoted a horizontal rod bearing a counterpoise, and a copper wheel preferably with an iron core attached to it, gyroscope fashion, by means of a copper frame. The copper frame is placed in an inclined position with respect to the horizontal. Under these circumstances a vigorous rotation is communicated to the gyroscope wheel when the alternating field acts upon it. The copper frame shields one side of the wheel more than the other, and as a result the induced currents in the copper wheel are unsymmetrically placed with respect to its axes of rotation, and it experiences a violent torque.

These experiments can, by a little ingenuity, be endlessly multiplied when once the fundamental principle is grasped. Bodies can be made to rotate and move, taking their movements from the magnetized space in which they are placed, and without being supplied with current from an external source.

Prof. Thomson has, however, studied some curious cases of magnetic motion in which rotations are obtained when iron or copper pivoted discs are placed near to iron or steel bars in which the propagation of magnetism is throttled by closed circuits. If a longitudinally laminated iron bar has a closed copper band or coil placed round it at one point, and if such a bar is made magnetic by a periodic current traversing a magnetizing coil embracing another part, this structure becomes capable of rotating iron or copper discs held near it. The explanation of this effect is probably to be found in the fact that the closed embracing coil tends to throw off the magnetic lines of force laterally at that point. Consider a bar (Fig. 29) *A B*, in which lines of magnetic force are being established in the direction from *A* to *B*. That is to say, let magnetic induction be increasing in the bar in a direction from *A* to *B*; at C let there be a closed coil embracing the bar. The magnetic induction during its period of increase is setting up in this circuit an electromotive force which establishes in the circuit a current

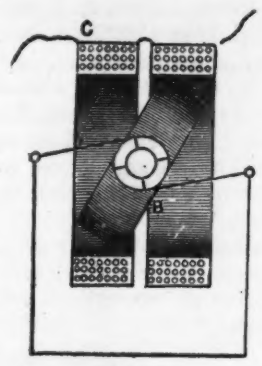


Fig. 33.

whose lines of force are opposed to the primary induction inside the coil, and therefore in the iron included in the coil, but in the same direction outside the coil, and therefore outside the iron. The result is as if the lines of primary magnetic induction in the iron were shed off laterally and escaped round the coil. When the magnetic induction in the iron, due to the magnetizing coil, is made periodic, this action will create a kind of lateral pulsation of the magnetic lines of force in the neighborhood of the closed coil. If, then, a movable conductor is held near such a magnetically throttled bar, it will be subjected to a displacement of lines of magnetic force through it laterally, and will hence have eddy electric currents generated in it. These currents, persisting into the period of reversal of the field in virtue of self-induction in the conductor, will cause the portion of the conductor in which they are

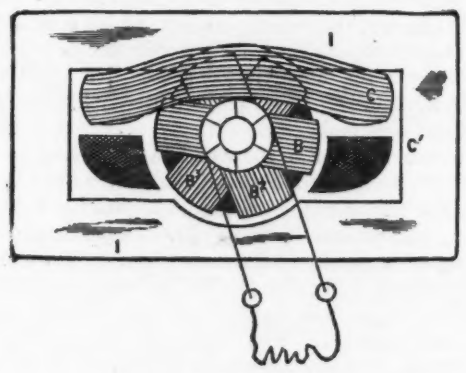


Fig. 34.

set up to be continuously repelled, and hence to take up a motion of rotation. A ring of cast-iron having a closed coil wound on it at one point, is held so that another point on its circumference 90 degrees removed from the closed coil, is on the pole of an alternating magnet. An iron disc centrally pivoted and held concentric with the ring, is rotated when the magnet is energized by an alternating current. It is not even necessary to have a closed coil on one part of the active magnetic bar, provided that this bar is not laminated, or, better still, is made of hard steel. In

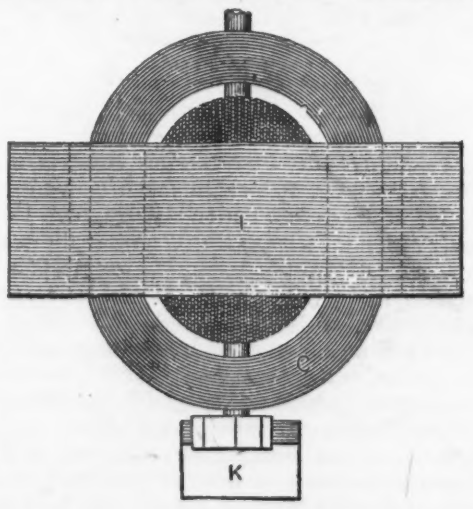


Fig. 35.

these cases there is a lag in magnetization due to either eddy currents set up in the bar or to hysteresis, and the result is a lateral escape of lines of force out of the bar when it is held with one extremity on an alternating magnetic pole. Then there is in these cases an action which is a true "magnetic self-induction." In the case of electric circuits, if we join in parallel two circuits, one having very small ohmic resistance and very high self-induction, and the other very large ohmic resistance and small self-induction, a sudden flow of current chiefly selects the path of least self-induction for its flow during the variable period, although during its steady period it will chiefly flow by the path of smallest ohmic resistance; so in the case of a magnetic and conductive circuit of low magnetic and electric resistance (iron), shunted by a path of high magnetic and electric resistance (air), rapid variations of magnetic induction bring

about a state of things in which the magnetic induction seems to chiefly select the path not of least but of greatest magnetic resistance during the variable period. Time will not permit me to develop at greater length the analogies of the magnetic and electric circuits under the conditions of rapidly periodic magnetic induction and electric current; but there are many suggestive ideas which arise when we place before our minds the notion of a magnetic self-induction, which is the consequence of a time-element coming into action in the setting up of induction in a magnetic and conductive circuit, and due to the production of electric eddy currents, just as the electro-magnetic or ordinary self-induction is the consequence of the time element coming into action in the setting up of an electric current, and due to the production of a surrounding magnetic field. Just as the rise of current strength under an impressed electromotive force acting in a conducting circuit is retarded by linking that conductive circuit with a magnetic circuit, so the rise of magnetic induction under an impressed magnetizing force, acting on a magnetic circuit, is retarded by linking that magnetic circuit with an electric conducting circuit. I am under the impression that Mr. Oliver Heaviside has developed these notions in a mathematical form, but am unable at the moment to place my hands on the results. The effect, however, of a bar of unlaminated iron when surrounded by a magnetizing coil at one end and traversed by a periodic current is to cause rotation in copper or iron pivoted discs held near it, or when such a bar of non-laminated iron is abutted on the pole of an alternating magnet. A bar of steel, even if not laminated, is able to cause brisk rotations in copper or iron discs under the same circumstances. With hardened steel the action is more marked. Here the hysteresis retards the propagation of the magnetic wave. By laying a large file flatwise against the alternating magnetic pole at about the middle of the file, discs of copper or iron may by kept revolving if held ever those portions of the file which project from the pole of the magnet (Fig. 30). In this case the magnetic retardation in the bar is brought about by its own chemical structure, and not by embracing it with a closed conducting circuit. The result is, however, the same in kind; there is a sluggishness in the establishment of the magnetic induction on the steel or iron under the action of magnetizing force which partly depends on eddy currents in the mass of the metal and partly on hysteresis. As a consequence, we have a periodic lateral displacement of the field. This question of a magnetic leakage dependent on a retardation of induction deserves special attention in the case of commercial alternate-current transformers. Time will not permit me to enlarge on it here to any great extent; but I may observe that in the design of closed iron circuit transformers this magnetic leakage should not be neglected.

In a closed iron circuit embraced at one part by a magnetizing coil and subjected to rapidly reversed magnetic force, the magnetic induction does not confine itself wholly to the path of least magnetic resistance, viz., the iron path, but takes a short circuit in part across the interior air space. This waste field may in badly designed transformers be something considerable. I believe that an important point to hold in view in transformer construction is to subject the iron circuit uniformly to the magnetizing force, by embracing all portions of the iron circuit with primary windings, and not locating the windings simply at one part. There is then a tendency to check the production of waste field by the lateral bulging-out of the magnetic lines of force from the iron. In Fig. 31 is a diagram illustrating the arrangement of primary and secondary coils most favorable for the production of waste field, and in Fig. 32 the arrangement least favorable for the same.

The foregoing experiments are of such a nature as obviously to force on us the thought that useful and perhaps important applications can be made in electro-magnetic machinery. Professor Elihu Thomson has, as you can imagine, not been slow to do this; for in him is united both a keen scientific sagacity and that clear mental vision which enables him to pursue to its logical issue in practice the consequences of scientific discovery. He has already applied these principles to the construction of alternating-current indicators, alternating-current arc lamps, regulating devices for alternating currents, and to rotary motors for such currents. For current indicators, a pivoted or suspended copper band or ring composed of thin washers piled together and insulated from one another and made to carry a pointer or index, has been placed in the axis of a coil conveying alternating currents whose amount or potential is to be indicated. Gravity or a spring is used to bring the index to the zero of a divided scale, at which time the plane of the copper ring or band makes an angle of, say, 15 to 20 degrees with the plane of the coil. This angle is increased by deflection more or less great, according to the current traversing the coil. The instrument can be calibrated for set conditions of use. Time would not permit of a full description of these arrangements as made up to the present.

In arc lamps the magnet for forming the arc can be composed of a closed conductor, a coil for the passage of current, and an iron wire core. The repulsive action upon the closed conductor lifts and regulates the carbons in much the same manner that electromagnets do when continuous currents are used. The electro-inductive repulsive action has also been applied to regulating devices for alternating currents, with the details of which I cannot now deal.

For the construction of an alternating-current motor which can be started from a state of rest the principle has also been applied, and it may here be remarked that a number of designs of such motors is practicable.

One of the simplest is as follows: The coils *C*, Fig. 33, are traversed by an alternating current, and are placed over a coil *B* mounted upon a horizontal axis, transverse to the axis of the coil *C*. The terminals of the coil *B*, which is wound with insulated wire, are carried to a commutator, the brushes being connected by a wire, as indicated. The commutator is so constructed as to keep the coil *B* on short circuit from the position of coincidence with the plane of *C* to the position where the plane of *B* is at right angles to that of *C*, and to keep the coil *B* open-circuited from the right-angled position or thereabouts to the position of parallel or coincident planes. The deflective repulsion exhibited by *B* will, when its circuit is completed by the commutator and brushes, as described, act to place its plane at right angles to that of *C*, but being then open-circuited its momentum carries it to the position just past parallelism, at which moment it is again short-circuited, and so on. It is capable of very rapid rotation, but its energy is small. He has extended the principle to the construction of more complete apparatus. One form has its revolving portion or armature composed of a number of sheet-iron discs wound as usual with three coils crossing near the shaft. The commutator is arranged to short-circuit each of these coils in succession, and twice in a revolution, and for a period of 90 degrees of rotation each. The field coils surround the armature, and there is a laminated iron field structure completing the magnetic circuit.

In Figs. 34 and 35 we have diagrams which will give an idea of the construction of the motor referred to. *C C* are the field coils or inducing coils, which alone are put into the actuating alternating circuit. *I I* is a mass of laminated iron, in the interior of which the armature revolves with its three coils, B, B^2, B^3, wound on a core of sheet-iron discs. The commutator short-circuits the armature coils in succession in the proper positions to utilize the repulsive effect set up by the currents which are induced in them by the alternations in the field coils. The motor has no dead point, and will start from a state of rest and give out considerable power, but with what efficiency is not yet known. A curious property of the machine is that at a certain speed, depending on the rapidity of the alternations in the coil *C*, a continuous current passes from one commutator brush to the other, and it thus performs the function of converting some electric energy from an alternating to a continuous form.

A small motor of a curious type has been made, utilizing the principle of "shading" the pole by closed circuits. A laminated ring (Fig. 36) is wound over with wire, but has a slot cut through it, dividing the ring and causing it to present two pole faces opposite to each other at the cut part. Each pole is arranged by a set of closed copper bands to be "shaded." A copper disc, free to turn on a shaft, is introduced by one edge into the air-gap in the magnet, and turns rapidly when the magnet is excited. A silver coin held just at the edge of the air-gap in such an alternating magnet with shaded poles is drawn into the interpolar space and propelled with some force through the same; but a lead disc or coin of base metal is not acted upon nearly by the same force, owing to its inferior conductivity. I have left myself but little time to speak of numerous applications of these principles in alternating current meters. The well-known meter of Mr. Schallenberger was described to you here quite recently by Prof. Forbes. There is, however, a new form of meter, designed by Messrs. Wright and Ferranti, which exhibits in a most beautiful manner a practical application of some of those principles which have briefly occupied our attention (THE ELECTRICAL WORLD, June 7, 1890, p. 386.)

It would take me beyond the limits of the time during which I am permitted to trespass upon your attention if I were to attempt to exhaust the list of electro-motor appli-

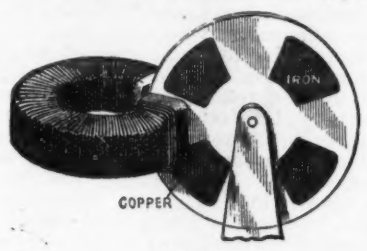


FIG. 36.

cations that have been made of these electro-magnetic repulsions. That is a subject important enough to deserve a separate treatment. In Berlin, not long ago, I saw a most ingenious form of self-starting alternating-current motor, the invention of Herr von Dolivo Dobrowolsky, in which the rotating portion was merely a solid iron cylinder constituting a commutatorless armature, revolving in an alternating field, and which acted in a perfectly marvelous manner. The region of practical invention here opened is a very wide one; and I have, therefore, ventured to direct your thoughts to it to-night, confident that its character in this respect deserves all the attention it can obtain, and that a firm foundation for it is laid in these interesting researches of Prof. Elihu Thomson.

The Comparative Cost of Storage Batteries and Horses in Street-Car Traction.

BY PAUL GADOT.

FOURTH. *Four groups of accumulators per day, each for 25 kilometres. System of battery tenders.*

Omitting the details given in the previous cases, we have the following

Recapitulation for a line of 20 cars of 50 seats each, using battery tenders and four groups of batteries for running each 25 kilometres per day; annual expenses:

	Francs.
a. Salaries at station	38,100
b. Drivers	63,000
c. Motive power	80,602.95
d. Interest (batteries)	5,292.30
e. Repairs to batteries	17,641
f. Deterioration in plates	79,768
g. Interest, motors, and machinery in cars	3,900
h. Repairs " " " " "	11,250
i. Abatement, dynamos, and machinery in cars	13,000
j. Tenders	4,232
k. Oils, waste, dynamos and machinery in cars	20,075
l. Maintenance and renewal of tools in the depot and on cars	6,000
m. Interest, deterioration, repairs on dynamos, transmitters, belts, etc.	5,760
n. Various items	10,000
Total for traction	358,621.25

The annual number of kilometres traversed by all the cars of such a line being $(100 \times 20 \times 365 =)$ 730,000, the cost of traction per car per kilometre is .491 franc.

The approximate capital necessary for installing battery traction with four daily groups of storage batteries per car will be:

	Francs.
Engines and boilers, 210 h. p. at 750 francs	108,000
Dynamos for charging transmitters, etc	23,040
Fitting up station, construction, etc	18,000
Storage batteries	88,205
Alteration of cars	65,000
Tenders	21,160
Tools, etc	6,000
A horse	1,200
Extras	21,595
Total	352,000

Or $\frac{352000}{20} = 17{,}600$ francs per car in service.

FIFTH. *Observations on the Output of the Plates.*—As in the case of the automobile car, this question is of importance. The conclusions reached in the cases of two and three groups will be the same as there given (p. 374), namely,

With two groups the output per kilogram of plates would be 1.31 ampères.

With three groups, 1.97 ampères.

With four groups, 2.63 ampères (not 2.77, as in the case of the automobile car, where there were twenty-one cars in service, while here there are but twenty).

In short, in regard to output, it may be said that the conditions in the case of two groups of batteries per car per day are good; in the case of three groups they are acceptable; four groups give a rate that is too severe and that might cause a greater destruction of the plates than that for which we have allowed; and the hypothesis of five groups must frankly be rejected, as demanding from the plates an output decidedly too violent.

Conclusions as to the battery tender.—With one group of storage batteries per car per day the weight of the accumulators is so great that the system must be discarded.

With two groups the cost per car per kilometre is .551 fr., and the average output of the plates is suitable.

With three groups the cost is .507 fr., and the output still acceptable.

With four the cost is .491 fr., but the mean output is much forced.

With five or more groups the cost of traction becomes greater and greater, and the output of the plates is so excessive as to increase very considerably the cost per car-kilometre.

Accordingly, under the conditions supposed by us, the case of three groups of accumulators per car per day, with a moderate output, and a probable cost of .507 franc per car-kilometre, seems to us most favorable, and most wisely adopted when the circumstances of the case permit. Under other conditions the conclusions reached might vary from ours, since our study has attempted to give approximate results for the tramways of Paris, but only to furnish a basis of calculation for other systems.

The cost in using three groups per day is here, it will be noted, the same as in the case of the automobile car, *i. e.*, .507 fr. per car-kilometre. The tender system, however, seems to us to have the advantages of the locomotive and of the motor car, and to avoid their disadvantages, notably the great inconvenience in the motor car system of reconstructing the cars now in use.

IV.—ANIMAL TRACTION.

The cost of traction on the tramways of Paris in 1883 was .643 franc per car-kilometre; in 1884, .594 franc; in 1885, .549; in 1886, .542; in 1887, .518; and in 1888, .519.

These six years were very favorable to economy. The figures given are official, and they average at .561 franc per car kilometre.

V.—GENERAL CONCLUSIONS.

The economy of electric traction, either using the motor car or the battery tender, as compared with animal traction as now used in Paris is thus seen to be the difference between

Present cost per car-kilometre	.561 fr.
And cost per car-kilometre with three daily groups (best)	.507 "
Or a saving per car-kilometer of	.054 fr.

But there are several further points in which the use of electricity is of advantage, notably in the matters of paving, rent, and interest of stations, etc.

The roadbed and rails will need no more and no less repairing under the new than under the old system. But the paving between the rails will surely be greatly economized, say by one-third. The tramways of Paris spend on an average .027 franc per car-kilometre in paving between the rails; one-third of this would be a saving of .009 francs per car-kilometre, bringing the economy of electricity up from .054 to .063 per car-kilometre.

As to rent of stables, stations, etc. (or interest at six per cent. on capital invested therein), the present expenditures in the Paris system coming under this head amount to .117 per car-kilometre. But the space needed per car in horse service is 68 square metres. In the new system such is the saving by the absence of horses that this item is decreased one-half, or to 34 square metres. Here is a further saving of .058 franc per car-kilometre, and the total economy is increased from .063 franc to .121 franc per car-kilometre. In other words, the total cost of traction, repaving and rents becomes:

At present	.705 francs
Under the new system	.584 "
An economy of	.121 "

per car-kilometre, or about 17 per cent.

And it should furthermore be borne in mind that the showing here given for horse-traction is the best possible, while the developments in electricity render probable a constant improvement over the figures given for electricity.

The other advantages of this system of traction are too well known to need more than a mention: considerations of health, ease with which service can be increased or even doubled in commission hours, removal of much of the manure now dropped on the streets, etc., etc.

We believe, therefore, that from every point of view the system of storage battery traction should be adopted on the tramways of Paris and of other large cities.

Indoor Insulation.

The Interior Conduit and Insulation Company has just issued a little pamphlet of 12 duodecimo pages, in which we find not merely the usual list of the company's officers, patents and inventions, but also some interesting and really valuable remarks upon insulation. The company is organized for the purpose of introducing an insulated conduit or tube, and auxiliary devices, constituting a complete system of insulating and installing electric conducting wires in buildings and mines, in railways and marine craft, in underground conduits and in all other locations in which wires are employed for the purpose of distributing electricity. It owns many patents covering the improved methods of doing this work, and is provided with substancial financial backing.

We take the liberty of quoting very liberally from the chapter on insulation in the company's prospectus:

"Prior to the inauguration of what may be termed the new electric era electricity was used almost solely for the purpose of transmitting intelligence; the telegraph, the telephone, the fire-alarm, the various signaling systems and kindred applications, are examples of such use. In these industries the insulation of the wires has but one

function, viz.: That of maintaining an effective service. If the insulation fails the service fails; no other untoward result follows, for the reason that the currents employed are so weak as to be incapable of developing any considerable degree of heat. With the inauguration of a new era involving new applications, as, for example, electric lighting, electric motive power, and kindred uses, employing electricity under high pressure and in vast quantity, there was imposed upon insulation an additional duty, viz.: that of protecting life and property. If herein the insulation fail, not only does the service fail, but life and property are at once seriously jeopardized.

"As a matter of fact, the one branch of electrical science which has not advanced in line with the new demands is this safeguarding of property from contact with the always-possible abnormal heat development in the wires. It has been assumed by some that inasmuch as electricity was inherently safer than other mediums of lighting, the element of danger was practically absent, and by others that the danger could be sufficiently avoided by improvement in the quality of the insulation; hence the evolution of a host of 'improved insulations,' many of which doubtless possess great virtue; but unfortunately they all follow one principle, viz.: That of affixing the insulation to or drawing it upon the wire itself. This is the fatal error. The logic of all the relating facts in the art is against such practice. Modern electrical service is nothing more or less than a service for the distribution of heat. True, economical considerations demand, and physical laws permit, that the conductors conveying this heat shall be so arranged and so proportioned as to remain cool, and therefore safe while doing the calculated duty demanded of them. But the proportions and conditions thus pre-arranged and determined to secure safety are liable to accidental derangement, thereby imposing a duty for which they were not calculated; in this event the conditions of safety are gone, and heat is at once developed in such proportion and in such place as the extent and the nature of the derangement may determine. It is apparent, therefore, that any system of insulation that aims to secure absolute protection must take cognizance of, and provide against, the effect of this always possible development of heat. Experience has demonstrated that the practice of affixing the insulation to the wires does not do this. All insulations that can be so affixed are of necessity compounded of oils, gums or other flexible and adhesive materials, all of which are readily affected by heat. Vain efforts have been made to find a new elementary material, or to compound known materials that shall have the multifold property of high insulation, great resistance to heat, extreme flexibility, and proof against acids, gas, etc. The great value to the art of an insulation possessing these naturally diverse qualities has been of late years so keenly appreciated as to concentrate the inventive mind on the line of its pursuit to the exclusion of any consideration of other methods of protecting the wires. This is the only explanation of the failure of the inventors to evolve a natural and effective solution of the problem. Necessity has been well said to be the 'Mother of Invention,' and it was by virtue of the necessities of himself and the numerous friends who depended upon him for advice in such matters that Mr. Edward H. Johnson was led to suggest the total abandonment of the old practice, and the substitution therefor of an enclosing tube, separate from, but forming a channel for conducting wires, continuous throughout their every ramification, thus fully protecting every inch of wire and rendering it accessible for periodic inspection or renewal, and by the same means absolutely confining within the safe limits of a non-inflammable channel the possible heat development.

"The practical efficiency of such a method scarcely needs to be supported by argument or demonstration. Its very simplicity appeals at once and alike to the intelligence of the expert and the layman.

"The elimination of the element of extreme flexibility as an essential requisite of insulation simplifies the problem, and permits of the employment of a variety of materials not at all available in the practice of affixing the insulation to the wires. Thus the door is opened and the inventor now comes forward to provide the requisite perfection of detail. In this respect the industry is extremely fortunate in the chance which has brought to its aid Mr. Edwin T. Greenfield, a man of wide experience in the old method, and therefore keenly appreciative of its weakness.

"In further pursuance of the conditions of safety, Mr. Johnson has incorporated with the new system a special conductor upon which he has been at work for some years, the function of which is to convert conditions favorable to a prolonged heat presence into conditions of instantaneous action hereinbefore described as a factor of safety.

"This conductor is so constructed as to convert all defects which may develop in the wires, such, for illustration, as a break, a leak, an imperfect union or other faults common to all systems of energy distribution, into that one defect or fault which is peculiar to electrical distribution and which is technically known as a 'short circuit.' This is a fault which develops instantaneously an abnormal concentration of energy, and in consequence effects the immediate destruction of the weakest link in the chain which supports the current. Much has been said and written of the device known as the 'safety fuse', and rules and regulations enforcing its use are universal. It is introduced as a link in every electrical chain and is designedly made the weakest link therein—hence a 'short circuit' simply means the destruction or giving way of this link, thus insuring by the breaking of the chain the total and absolute cessation of the electric current previously supported thereby. This weak link is, of course, located within safe pockets where the somewhat violent results of its disruption are smothered or otherwise rendered abortive.

"Contrary, however, to popular belief, this device does not provide absolute protection. Its failure to do so arises from the fact that it is only affected by an overloading of the chain.

"It is, of course, apparent that a partial break, an imperfect union, or a leakage of the current, may develop a sufficient degree of heat to effect the ignition of inflammable materials, and yet not sufficiently increase the current strength to overload and fuse the safety link.

"The object of the special conductor herein alluded to is to convert with absolute certainty all defects, whether a break, a leak or other fault into a 'short circuit,' and the consequent overloading and fusing of the safety link.

"The effect of a 'short circuit' is generally apparent at the point of its occurrence in the form of an instantaneous flash, hereinbefore alluded to as ineffective of much damage because of its brief duration.

"It is possible, however, to have present conditions of extreme inflammability, as for instance gases, inflammable powder, as in a flour mill, lace or other delicate fabrics, or even the insulation of the wires themselves.

"It therefore becomes a matter of considerable importance to safely localize even this flash, and it is obvious that the inclosing tube does this to perfection, in that every inch of the wire is completely incased within the safe confines of its fireproof interior.

"The Interior Conduit and Insulation Company now enters the field with this new method of insulation, and claims that it is able to effect, not partially and imperfectly, but completely and absolutely, that safety which is the one essential to the general adoption of electricity. That this claim is not unsupported is attested by the indorsement the system has already received by architects, electricians, fire underwriters, municipal and other authorities interested in the matter of safeguarding property, and the extraordinary rapidity with which it has been accepted by the public."

The president of the company is Mr. Edward H. Johnson, and the vice-president Mr. Sigmund Bergmann. The company announces that, while amply protected by letters-patent, it purposes depending more upon business principles and sound methods of introduction than upon immunity from competition. New and large factory facilities have recently been provided, and it is now possible to meet the considerable demands of the present and the very greatly enlarged output expected in the future.

The Double Carbon Lamp Litigation.

The following decision has just been rendered in the case of the Brush Electric Company vs. the Sperry Electric Company, in the Circuit Court of the United States for the northern district of Illinois:

Gresham and Blodgett, JJ.: This cause having been brought to a hearing upon the motion of the complaint upon the bill and affidavits for a preliminary injunction to restrain the defendants, the Sperry Electric Company, from infringing complainant's letters patent, No. 219,208, granted to Chas. F. Brush, Sept. 2, 1879, and assigned to complainant, by making, using or selling double carbon lamps embodying the invention or inventions of said patent, and having been argued by H. A. Seymour, for complainant, and F. W. Parker, for defendant, and the same having been duly considered, the Court finds as follows: to wit:

1. That the double carbon lamps manufactured by the defendants, the Sperry Electric Company, and produced before the Court, viz.: one marked "Complainant's exhibit New Sperry Double Carbon Lamp," wherein the two pairs of carbons are independently actuated and adjusted and burned successively, the feeding carbon of one pair having a supplemental clamp or device whereby it may be manually latched up and retained, separated from its mate during the burning of the other pair, the latched-up carbon being then automatically released, and the arc established and maintained between the second pair of carbons until consumed, the other lamp, the construction of which is shown in defendant's drawings, numbered 7 and 8, and wherein the two pairs of carbons are independently actuated and controlled and burned successively, and in which the feeding carbon of the idle pair is required to be manually latched up to insure such successive burning of the two pairs—each embody the invention of Charles F. Brush, as described in said letters patent No. 219,208 and specified in the first six claims thereof, and that the complainant is entitled to an injunction as prayed for, restraining the defendant company from manufacturing, selling or using either of such infringing lamps until the final hearing of this cause.

It is therefore ordered, adjudged and decreed, that the defendant, the Sperry Electric Company, its officers, agents, attorneys and employés, be, and they are hereby enjoined until the final hearing of this cause, from directly or indirectly making, selling, offering for sale, or using any double carbon lamps, like or similar to those mentioned in the finding above set forth, or any arc electric lamps in which two or more pairs of carbons are independently adjusted and regulated, and are burned successively to secure the continuous burning of one pair of carbons prior to the establishment of the arc between the other pair, substantially as set forth and claimed in the first claim of letters patent No. 219,208; and also from making, using or selling any electric arc lamps containing the inventions set forth and claimed in the second, third, fourth, fifth and sixth claims, or any of said claims in said patent No. 219,208, this order and decree to take effect on and after July 3, 1890.

The Hartford Secret.

A representative of the *New York Tribune* has been making praiseworthy but ineffectual efforts to pry into the secrets of Mr. H. B. Cox, the gentleman who has convinced Hartford capitalists that he can produce electricity directly from heat. Like the less respected Keely, Mr. Cox and his friends are not at present taking the public into their confidence. The president of the new company, Mr. Francis A. Pratt, was asked the other day to give a reporter some facts for publication about the invention, but he most peremptorily refused to do so.

"Not for $100,000," said he, "would I have had anything published about that matter. Ever since the account appeared I have been overwhelmed with letters of inquiry from electricians, from representatives of companies that have millions invested in electric patents and plants, from scientists and from people who want to know from idle curiosity. All this deluge has come upon us before we are prepared for it. A Hartford reporter, who had been nosing around for weeks picking up what he could and putting in gossip where he did not have facts, in violation of a promise to write nothing until he knew it all, printed that story."

"The truth is," continued Mr. Pratt, "we cannot say positively that we have accomplished more than other inventors and workers in electricity. The matter is still in an experimental stage, and it may turn out to be nothing at all. But we have been sufficiently encouraged by what we have already seen to spend some more money in experimenting, and by the coming fall, at the latest, we will know what we have got. If we have got anything new to science or the industrial world we will, of course, show it to the public. In the meantime we are engaged in perfecting our patents, and a publication of what has been done might prove an irreparable injury to us. I have been surprised, I must confess, at the general public interest shown in the matter."

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York, June 14, 1890.

Oil Filters.—The original oil filter was made by the Waste Oil Filter Company, 322 Pearl street, who claim that all oil filters made by any other company are infringements on their patents.

Hanson, Van Winkle & Co., Newark, N. J., and 81 Liberty street, New York, have made a special addition to their business They now install dynamos and motors for light and power service, and are already doing a good business in the new department.

The Lewis & Fowler Manufacturing Works, 48 Wal worth street, Brooklyn, were damaged by fire a short time ago, but are now again in running order. All the cars on the Coney Island & Brooklyn Electric Railway were furnished by this company.

The Clark Electric Company, 192 Broadway, are doing an excellent business in their arc lamps on incandescent circuits. Two of their arc lamps in series were recently put in the Grand Central Station and are reported to be operating satisfactorily.

The Crocker-Wheeler Motor Company, Washington, Thirteenth and Fourteenth streets, New York City, are building up an extensive business in motors of all sizes and for all sorts of applications. The latest is the attachment of a motor to the revolving apparatus of a gatling gun.

The Field Engineering Company, 15 Cortlandt street, have nearly completed the laying of 40,000 feet of interior conduit for the Detroit Electric Light and Power Company. The Field Company secured all the construction work on the Thomson-Houston railway plant at Newark, N. J.

The McCreary Electrical Specialty Company, 18 Cortlandt street, have taken a large loft at 24 Cortlandt street, which they will use for storage. This will enable them to carry a full line of samples at their office. Supply houses and buyers generally would do well to give them a call, as they have the best of goods.

Himmer & Anderson, 22 Vesey street, manufacturers of the restorable dry battery, are kept very busy with the orders they receive for their battery. The Paul Seilers Electrical Works, San Francisco, Cal., has the agency for their specialties, which may now be found on sale in electrical supply houses on the Pacific coast, as well as in the East.

The Seeley & Taylor Manufacturing Company, 24 Cortlandt street, are getting their new sales, stock and exhibition rooms into shape for the reception of buyers and those who want plants installed, submarine cables laid, wires or cables laid in conduits, etc. The new rooms extend from Cortlandt through to Dey street, and give large floor space for showing their goods.

Mr. Joseph W. Marsh, secretary of the Standard Underground Cable Company, Times building, New York, has just been elected assistant general manager, retaining also the title and duties of secretary. This company is actively at work on the building of very extensive new factories at Brinton, Pa., which are expected to be among the most complete wire and cable works in the United States.

Electrical Cabinet Work.—This new field for cabinet work is well occupied by the Charles N. Swift Manufacturing Company, 82 John street. Annunciator and burglar alarm cases, telephone transmitters and battery boxes, cases for medical batteries and bases for all kinds of electrical instruments, push buttons, shells, etc., are supplied to the electrical trade at the lowest possible prices consistent with good work.

Homer Brook, whose place of business is at 44 Barclay Street, is a practical mechanic of more than twenty years' experience in making molds for casting glass, zinc, lead, platinum etc., for electrical purposes. Mr. Brook will undertake the making of the most difficult patterns, and the uniform success he has met with in his former labors with work that required an expert hand and brains, warrants him in guaranteeing satisfaction, no matter what may be the pattern desired.

The H. W. Johns Manufacturing Company, 87 Maiden Lane, are the oldest manufacturers of asbestos, cement felting and sectional pipe covering, and are doing an extensive business in covering boilers and steam pipes all over the country. They have lately obtained the contract from the Westinghouse Air Brake Company for applying asbestos coverings to the entire steam plant of their new shops at Wilmerding, Pa. This is one of the largest contracts of the kind ever given out.

Drill Presses.—Wm. Gardam & Son, 98 John street, New York City, have a light sensitive drill press that is especially valuable for use in shops where apparatus is made for telephone, telegraph, electric light and power, or any other grade of work where delicate work demands light, accurate, sensitive machinery. Besides the drill presses, the firm make all sorts of models for experimental work in the electrical or any other mechanical line. An illustrated catalogue will be furnished on application.

Hazazer & Stanley, 32 and 34 Frankfort street, New York, have given to T. W. Ness, of Montreal, the sole selling right in Canada of their dust proof bells. Lois Bates, the popular electrical engineer of Hoboken, N. J., has bought 4,000 of these bells in the past four years. The bell is evidently a good one, and fulfills all that its owners claim for it. The Empire Electrical Manufacturing Company, of Brooklyn, say that they have used several thousand, and that twenty-five years in the business has failed to make them acquainted with a bell that is so well finished or so perfect in operation.

Grosche & Bigler, 36 Vesey street, New York City, have an oil purifier that seems to be rapidly taking the place of the oil filter. It combines in one the tank and filter, and renders the old oil as good as new, thus saving its cost in a few weeks. No matter how dirty or gummed the oil is before it enters the purifier, the firm guarantee that it will emerge as fresh and useful as before it was put on the machinery. A good purifier is a desideratum in any central power house, and the effectual working of this commends it to those who have machinery to attend to. It will be placed on trial for acceptance.

Austin Adams is the sole agent for the Hallock damper regulator for steam boilers. Mr. Adams' office is at 40 Dey street, this city, and he is doing all the business that he can find time to attend to. This regulator is sufficiently well known to our readers to

need no special description of its appearance or efficiency. The time has gone by when the Hallock regulator was an experiment, and it now stands upon the market a long since completed success. Mr. Adams states that he has never yet had to take out a damper for unsatisfactory working. Prices and descriptive circulars will be furnished on application.

C. O. Mailloux, the expert electrician and engineer, whose office is at 32 Liberty street, was met by your correspondent last week while returning from Newport, R. I., where he had been inspecting the work on the grand residence of Edward Goelet. Mr. Mailloux drew all the plans and specifications for the electrical work that is being done on this beautiful home, for which the Tucker Electrical Construction Company of New York have the contract. Mr. Mailloux invented, some time ago, a complete traction car with motors, trucks, etc., and has had it on exhibition at Washington, D. C., whence daily reports speak of its satisfactory operation. Electrical accumulators are used.

Detroit Motor.—Hatzel & Buehler, 29 West Twenty-six street, are sole agents for this motor, and have recently made many very gratifying contracts. Several have been placed by them in the Grand Central Station, and recently they put in 12 for Stern Bros., the dry goods merchants, for use in ventilating their large building. Electric wiring and the equipment of electric railways are also attended to by this firm, and all other work that has to do with electricity. Among the contracts that they now have on hand are Havemeyer's building, Sixty-sixth street and Fifth avenue, 456 lights; Oriental building, this city, 300 lights; Beadleston & Woerz, brewers, overhauling plant and placing new lamps; J. H. Rechnagle's cottage, at Great Neck, L. I., to be lighted throughout; Barrington apartment house, increasing and improving plant. They are also supplying the apparatus for firing guns that is to be used on the flagship "Electric."

A Volcano in Broadway.—For some weeks past a pest-hole has existed at the corner of Fulton street and Broadway, caused by excavations made at the point of meeting of half a dozen old and rotten gas mains. On the evening of June 11 the Steam Heating Company, which had dug the trench, began filling it in. The stench was horrible; but no effort was made to stop the leaks in the gas mains, the only desire being to bury the health-destroying medium, so that it should gradually filter into cellars and subways, instead of openly offending the nostrils of the throng always present at this corner. This effort to conceal the iniquitous nuisance was unsuccessful. A workman stumbled, his lantern dropped, and in an instant there shot out of the hole a pillar of fire that burned for the next 18 hours, stopping all traffic for an entire day at the busiest point in the city, and doing thousands of dollars worth of damage to mains and subways. The accident will prove of value to New Yorkers if it convinces them that public safety is more menaced by gas lighting and steam heating than by the electrical transmis sion of light and power. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
No. 146 Franklin, corner Congress St.
BOSTON, June 14, 1890.

Amesbury, Mass.—Mr. W. M. Todd, late manager of the Clinton Telephone Exchange, has been placed in charge of the local exchange.

The Municipal Signal Company, of Boston, have secured the contract for equipping the Georgetown, D. C., police precinct with their police alarm and inter-communication system.

Holyoke, Mass.—The local electric light company will call for plans and specifications for their new building as soon as representatives of the company have looked over model plants in some of the large cities. A tour will be made about the middle of next month.

H. E. Swift & Co. are receiving some very large orders for the new "Brodie" tree insulator. This enterprising firm are to move July 1 to larger and more commodious accommodations at 34 Oliver St. The removal is made necessary owing to rapidly increasing business.

Ellsworth, Me.—The Brush Electric Company, of Cleveland, O., has purchased the electric plant at this place. The property was sold at auction by the trustees. The Brush Company is building a new brick station and will make other extensive improvements in the system.

Mr. W. W. Burnham, the new treasurer of the Electric Gas Lighting Company, of Boston, is meeting with great success on his present western trip. This week he has sent in three different orders for 1,000 each of the Samson battery, besides large orders for burners and electric gas-lighting apparatus.

The Union Street Railway Company, of New Bedford, Mass., is making necessary repairs previous to operating cars by electricity. No poles have yet been set, but the work of laying the ground wire between the rails is progressing. Five new box cars fitted with motors have arrived. No open cars will be fitted with motors for the present.

Providence, R. I.—Mayor Barker has vetoed the resolution providing for a contract with the Narragansett Electric Lighting Company for the building of electric subways. The Mayor objected to the form of the resolution and the absence of certain provisos which appear to him to be necessary. This is the outcome of a contract which the company has been trying to arrange with the city for years.

Springfield, Mass.—A Springfield syndicate composed of John Olmstead, James D. Soffard, James Kirkham and H. H. Bowman have purchased 300 shares of the Holyoke Street Railway, thus securing a controlling interest, and the consolidation of the Springfield and Holyoke lines is now assured. It is thought that the transaction means the eventual opening of an electrical line from Holyoke to Northampton.

Lawrence, Mass.—The syndicate that recently purchased the Merrimac Valley Railroad has organized a company to construct a road between Lawrence and Haverhill, under the name of the Lawrence and Haverhill Street Railway. This syndicate also contemplates the building of a line from North Andover to Haverhill via Bradford: and the purchase of the Haverhill, Groveland and West Newbury Street Railway plant, thereby completing a line to the sea. Electricity will be used as the motive power.

The Johnston Electric Train Signal Company has purchased a valuable property in Woburn, Mass., which it will occupy and utilize immediately as a factory. The building is four stories in height, has a frontage of about 100 feet, and is upward of 200 feet long. It is located near the railroad and its facilities are excellent. The company will set up its machinery at once, and it is expected that a hundred mechanics will be at work within a month. The purpose of the concern is to manufacture not only the train signal, but push buttons of all descriptions and several electric hardware appliances.

Lynn, Mass.—The ice famine is proving a bonanza for the Thomson Welding Company. There is a great demand at present for pipe-welding machines, with which to make long coils of pipe for artificial ice machines for brewery, sugar refinery and general refrigerating purposes. By the old system the pipes are welded together by a slow and laborious process, requiring fifteen minutes, two blacksmiths and a dozen helpers; by the electric process the length of time required is two minutes for each weld, and all the help required is a man and a boy. The cost of the old process is 15 cents; of the new, 2 cents.

The Concord, (N. H.) Railroad is progressing excellently in its change from horse power to electricity. The poles are nearly all set for the whole distance (7 miles), the rails are all nearly ready to connect underground circuit, and work will begin this week on putting up the trolley wire. It is expected that the road will be in running order in about four weeks. The superintendent is a man over 80 eighty years old but he is pushing the change with an energy that is envied by many a younger man. He has had much to contend with in making this change, but has always overcome the opposition. THE ELECTRICAL WORLD congratules him, and trusts that he may live many years to enjoy the benefit of the change.

Concord, N. H.—Work has begun on the foundation for the new electric light station which the Concord Gas Light Company are building, and which is to be located just east of the Porter shoe factory. It is expected that the plant will be ready for use about the middle of September. The building is to be of brick, with clipped truss roof, slated, and measuring 14 feet in the clear. It will be one story. The main building facing Bridge street will be 68 feet wide and 90 feet deep, with a brick engine room in the L. The chimney will be 46 inches square and 100 feet high. The stone masonry is being done by Theobold, and Dow & Wheeler are the architects. The new station will be much more commodious and convenient than the old one, and will be supplied with testing rooms. The superintendent's room will be located in the building. The company is now running 174 lights.

Electric Welding.—The machines of the Thomson Electric Welding Company are gaining in popularity in exact proportion as they are becoming known. In the works of Roebling's Sons & Co., at Trenton, N. J., one of these electric welding machines has been in constant use since November, 1888, and has made more than 280,000 welds on telegraph wire. The firm have received such satisfactory service from this machine that they la y made a contract with the Welding Company for seven more, to weld copper wire from ⅛ inch to Nos. 16 or 18. This plant will cover the entire works, the welders being placed wherever they are needed and run from a large central dynamo. The Government has ordered for the New York Navy Yard a complete plant for welding boiler tubes, rods, bars, etc., and a similar plant is to be placed in the Norfolk Navy Yard. Both of these plants will be completed and installed within a very short time. The Welding Company is so crowded with orders that the present plant at Lynn. Mass., is very soon to be greatly enlarged. Plans for the additions have already been prepared. L. H. H.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 The Rookery, Chicago, June 14, 1890.

The Central Electric Company report having secured an order for 100 miles of improved Candee waterproof wire.

The Worrell Electric Construction Company has been incorporated at Chicago to construct and maintain electric plants, with a capital of $500,000. The incorporators are: C. E. Gaylord, M. J. Frost and C. Y. White.

The Burnley Dry Battery.—Since taking the western agency for the Burnley dry battery, the sales of the Central Electric Company have reached the thousands. This battery is being adopted by many companies and individuals who have been looking for a dry battery of merit.

Mr. S. J. Keese, president of the Rhodes & Keese Electric and Supply Company, 126 South Main street, Los Angeles, Cal., was in the city last week purchasing a heavy stock of supplies and arranging to handle various specialties on the Pacific Coast. Mr. Keese goes hence to New York and other Eastern points before returning home.

Mr. George Cutter, manager Great Western Electrical Supply Company, 192 Fifth avenue, Chicago, is in receipt of a telegram notifying him that a branch house has been opened in San Antonio, Tex., and that a complete line of supplies is being forwarded there as rapidly as possible. Mr. Cutter has also secured a complete line of electric and combination fixtures, and will carry the largest stock in the West, all being of new or standard designs.

Mr. Elmer P. Morris, President of the Novelty Electric Supply Company, of this city, has just invented and patented a complete double trolley wire railway system for overhead construction, which abolishes the many intricate switches, complications, etc., which have been the main objections to overhead double wire construction. It is also well adapted to single track roads with turnouts. He has also just placed on the market several new electric railway devices, which will be great improvements over the old style construction.

The Electric Merchandise Company, Chicago, the successors to the Sprague Equipment Company, have opened offices and show rooms at No. 11 Adams street, where they will carry a complete line of the various appliances used in the construction, operation and maintenance of electric railways, irrespective of the system used. They have a well-equipped factory, turning out not only the present standard appliances, but also many improvements. The general management of the company will be in the hands of Mr. W. R. Mason.

The Central Electric Company, Chicago, have just completed arrangements with The Butler Hard Rubber Company to handle their new product in hard rubber. They exhibit samples of this new material, showing that it can be easily turned, and takes a beautiful finish. To all appearances this is the best article in hard rubber that has yet been placed on the market. At the same time it is sold at a lower price than anything so far before the public. This rubber is made in the usual forms of sheet, rod and tube, and much demand is predicted for it.

Geo. H. Bliss and Joseph Angell have formed a co-partnership, and have opened offices in the Temple Court, Rooms 612-614, where they will do a general engineering and contracting business, and will pay particular attention to the furnishing of expert service. Mr. Bliss is well known throughout the country as an able expert electrical engineer and financier, while Mr. Angell was for many years superintendent of telegraph of the Delaware & Hudson Railway system, and also the general ticket agent of that line, and has an extended experience in the construction of electrical lines.

Pittsburgh, Pa.—The Duquesne Traction Company is going ahead rapidly with its street car line, which will extend from the heart of the city to Wilkinsburg, eight miles distant, and have a number of feeders. About the right of way for one of these feeders, that which is to traverse Hiland avenue, a fashionable drive-way of the East End, there has been trouble, an injunction against the Duquesne Company having been secured by a rival organization. The difficulty has ceased to exist by reason of a decision of Judge Paxon, of the State Supreme Court, and work will begin at once upon the Hiland avenue branch.

Telephone Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$295@$300	Cumberland	$ 59@ $60
Central Union	70@ 71	Wisconsin	116@ 117
Michigan	98@ 99	Bell of Missouri	140@ 145
Great Southern	30@ 32	Iowa Union	21@ 23
Colorado	38@ 40	Missouri and Kansas	54@ 55
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$104@$105	Chicago Edison Co	$125@$130

The Knapp Electrical Works, 54 Franklin street, Chicago, make a line of house bells that are noted for their durability, fine adjustment and handsome finish. They also make a specialty of furnishing heavy alarm gongs to fire departments, cable and electric railways, and for the engine rooms of mines and other points where a clear-sounding, perfectly-adjusted durable electric alarm gong is required. In the line of annunciators both for house and hotel use, and burglar alarms, there is no question about the high excellence of the Knapp annunciator. The constantly increasing demand for these goods, and the fact that various supply houses send in orders for a thousand or more to be placed in a special style of frame for their own trade and bearing the firm name, is a sufficient indication of their popularity.

A Police Signal Device.—Officer Michael A. O'Donnell, of the Central detail of the Chicago police force, has made good use of his spare time in devising improvements in the system of signalling for the patrol wagon. One of his latest devices is a brass plate secured to the end of the club, and having an opening of suitable shape to correspond with and act as a key or wrench to turn the lever that sends in the alarm. This same opening also serves as the mouthpiece to a whistle set in the base of the club. The advantages afforded are that it is often not only inconvenient, but almost impossible, for an officer to extract his keys from his pocket and send in an alarm at night when holding on to a specially "bad" man, who is determined to do all the evil possible, and who compels the officer to use both hands to hold him securely.

Fire Alarm.—The Western Electric Company, Chicago, are distributing a neat circular descriptive of their electro-mercurial fire alarm system, the value of which has been so often demonstrated. The system is simple in design and operation, and consists of a glass bulb in which a column of mercury moves up and down with the rise and fall of temperature. A platinum wire is sealed in the glass at each end, the lower wire in contact with the mercury at all times; the upper one, terminating just above its surface, is set so that the circuit will be closed at the proper degree of heat. It is always on duty, and never sleeps. The thermostats are inclosed in brass shields to protect them from injury, and fastened to the ceiling in all rooms, closets, etc., in hotels and like buildings. In large rooms, such as stores, warehouses and manufacturing establishments, one thermostat is placed every 15 or 20 feet, so that in no case can the heat spread more than 10 feet in any direction before its effect will be felt. In hotels and establishments where watchmen are employed the alarm bell is usually located in the building protected. In other cases a bell is connected in the fire-engine house, or wherever it will attract immediate attention. In Chicago, St. Louis, St. Paul and other large cities nearly all the more prominent business houses, office blocks and hotels are fitted up in one comprehensive system, which terminates in the fire insurance patrol station, the salvage corps headquarters, or in the city fire-alarm office, the alarm being received on a register similar to a regular city box system.

The Diamond K Combination Switch and Fuse Box.—A demand has sprung up for a device adapted for alternating current circuits, so simple in character that a glance at its mechanism will remove the fear of danger from the mind of the every-day layman, as well as render safe the work of the lineman; thus permitting the use of the alternating current in places of every character, whether in the moisture dripping packing house, or in the residence portion of a city. To meet this demand the Knapp Electrical Works, Chicago, are placing on the market a combined double pole switch and fuse box for alternating circuits, that is especially adapted for cutting out the converters from primary circuits whenever testing or repairing is necessary, or when a fire in a building may render it advisable to shut off the current, the device being placed between the converter and the main circuit. In the testing of tap lines the disconnecting of the line from the converter box is entirely done away with, it being necessary only to throw the switch, a point that will be fully appreciated by every lineman who has had to climb a pole to replace a fuse or test a line on a rainy day. The fusing attachments are located beneath the lower contacts of the switch, thus, when the latter is thrown, all danger of fusing from the primary current is obviated, irrespective of bad weather and the location of the converter in exposed places. The switch is made instantaneous in action, so that it is impossible for any sparking to occur between the contact points, when cutting a converter in or out of circuit, while the sliding method of contact prevents the accumulation of dirt and keeps the points bright. The device is arranged to be used either right or left handed. Various sizes of these combinations are made for all classes of work, and for exposed places the device is placed in a water-tight iron box, and the key so arranged that it can be removed if necessary. F. DE L.

SOUTHERN NOTES.

NORFOLK, VA., June 14, 1890.

Camden, S. C.—W. E. Glenn will establish an electric light plant, and is now in the market for machinery.

Marion, N. C.—A street railway company with a capital stock of $100,000 has been organized, and is now open to proposals for electric motive power.

Asheville, N. C.—The Asheville Electric Street Railway will extend its line to "Biltmere," the summer residence now being erected near Asheville by Mr. George Vanderbilt.

Quitman, Ga.—E. P. S. Denmark and Clayton Grover have made a proposition to light the town for ten years for $1,800 per year. A franchise to build a plant has been granted by the City Council,

Atlanta, Ga.—The telephone exchange now has over one thousand subscribers, and Manager W. T. Gentry is arranging plans for an exchange of twice the present size. He is now making many very important improvements to the service.

Milledgeville, Ga.—The electric light company, recently organized, has begun work with an excellent business, which is so

much larger than had been anticipated that a new dynamo has been ordered, with double the capacity of that used at present.

Monroe, La.—M. J. Dutz desires to buy one 600 incandescent light dynamo, one electrical cable for 60 arc light dynamo, 500 feet long; one electrical cable for 600 incandescent light dynamo, 1,500 feet long; three miles of insulated incandescent light wire and six hundred 16 c. p. incandescent lamps.

Morganton, N. C.—The Town Commissioners have entered into a contract with the Westinghouse Electric Light Company for the erection of an electric light plant furnishing 25 arc and 750 in. candescent lights, the contract being conditioned upon the acceptance by the director of the Western Insane Asylum located there of a proposition which the town will submit, to furnish 350 incandescent lights to that institution. Should the asylum not accept the proposition, which will be made on the basis of actual cost, a contract for a smaller plant will be given to the Westinghouse Company.

A New Conduit Company.—Messrs. Lawrence Westerland, T. J. Dorsey, and Albert Howell, Jr., have incorporated the Westerland Electric Conduit Company to manufacture and sell the patented conduit of Lawrence Westerland, and also to manufacture all other articles or machinery to which the principles operating this electric conduit may be applied. Their charter empowers them to operate electric lines, motors, cars, equipments, machinery and all articles in the manufacture or operation of which electricity may be used; to furnish for light, power or for other purposes, electricity to such persons or corporations as they may contract with. The paid in cash capital is $60,000, and the company has the privilege of increasing the capital stock to $5,000,000. V. N. B.

ENGLISH NOTES.

(From our own correspondent.)

LONDON, June 4, 1890.

Agitation Among Telegraphers.—The agitation among the telegraph clerks still continues. All the lower ranks of the post office service seem to be in a feverish state of discontent.

Bicycles for Telegraph Messengers.—A proposal has been laid before the Postmaster-General that telegraph messengers should be mounted on bicycles with the view of accelerating the delivery of telegrams. This scheme has met with considerable favor, and in streets such as the London ones, which are of the very best, it will no doubt answer very well.

Carbon Brush Patent.—With regard to the carbon brush patent, which has just been issued to Prof. George Forbes by your Patent Office, I may say that although the English one is more than five years old no active steps have as yet been taken to enforce patent rights, though, as you remark in a recent issue, the patent seems to cover the field pretty thoroughly.

The Patent Office Revenue.—The report of the Controller General of Patents for 1889 has just been issued. The number of applications for patents last year was 21,008, an increase of 10 per cent. on the preceding year, and 21 per cent. on the number applied for 5 years ago. The receipts from patent fees amounted to close upon £152,000. The total receipts from all sources amounted to £173,000. As the total expenditure was only £80,000, the surplus for the year was the handsome sum of £93,000.

The General Electric Power and Fraction Company.—A company with this title has just been formed with a capital of £350,000, to take over the businesses of the well-known motor makers, Messrs. Immisch & Co., and of the Electric Traction Company, which has been running a few accumulator cars on one of the metropolitan tramway lines. As close upon £250,000 is to be paid to the old concerns, the amount left available for the development of electric traction is not very large. It is to be hoped, however, that the new company will make the most of the advantage which it undoubtedly possesses, namely, considerable experience in the work, which it proposes to undertake.

The Lane-Fox Patents.—The Lane-Fox Electrical Company, to which I alluded in a previous letter, have already commenced their "royalty" campaign. The leading supply companies have been warned that they are infringing the Lane-Fox distribution patents Nos. 3983 and 4013 of 1878, and have been informed that if they agree to one of the following methods of payment they will be granted an indemnity up to the end of last year. The three methods of payment proposed are: (1) A charge of 1d. per B. T. unit supplied. (2) A charge of ¼d. per unit, to continue after the expiration of the patent, for such a term as would render that method equivalent to No. 1. (3) By a capitalized sum. As the metropolitan companies charge from 6d. to 8d. per unit, the payments under method 1 would mean a charge upon the company's gross revenue of from 12½ to 16 per cent.

The Telephone and Riots.—During the recent riots in Austria the great value of telephonic communication was made apparent even to the official mind. In many cases new lines were run up for the occasion, and so much was thought of the value of uninterrupted telephonic communication that the pole routes in some of the towns were carefully guarded by cavalry patrols. I may add that the telephone has proved itself equally useful in this country in similar emergencies. At the riots in Leicester some four years ago the telephone was instrumental in saving life. A large body of rioters set out from the town toward the house of an obnoxious employer in the suburbs with the most violent intentions. The obnoxious employer was, however, fortunately a subscriber to the Telephone Exchange, and received immediate telephonic intimation of the danger which threatened him, so that by the time the mob arrived at their destination they found the employer not at home.

Gas and the Electric Light.—There seems every probability that before very long the biggest gas company in the metropolis, the Gas Light and Coke Company, which employs considerably over 10,000 men, will shortly be face to face with a strike similar to that which was encountered at the end of last year by the South Metropolitan Company. One of the causes of this discontent among the men is due to the determination of the company to introduce machinery as far as possible. A strike among the workmen of this huge company would be a most serious matter for the metropolis; and following, as it would, close upon the heels of one which greatly inconvenienced the whole of the South of London, it is probable that by a sort of reflex action, the electric light would be perceptibly benefited. Simultaneously with this rumor of an impending strike there comes a general rise of about 22 per cent. in the price of gas.

The Halifax and Bermudas Cable.—The cable between our naval stations and Halifax and Bermuda, which is now in the course of being laid, inspired one of our daily papers, the *Morning Post*, to a leading article which has given rise to a good deal of amusement in submarine cable circles, where the prospects of the cable in question are not considered very great from a financial point of view. After enlarging upon the undoubted strategic importance of the cable, the *Morning Post* went on to say that, although it was true that the commerce of the Bermudas at the present time was not of colossal dimensions, nevertheless there was a good deal of garden stuff grown there, and, in addition, a famous lily flourished, the bulbs and blossoms of which were much in demand; the air was also said to afford an excellent tonic for sick Americans. The Cable Company enjoys a Government subsidy of £8,000 per annum, but beyond that, even on the showing of the *Morning Post* there is not much to be expected, for the most sanguine individual can scarcely convert garden stuff, lilies and sick Americans into a remunerative source of revenue.

The Australasian Cable Rates.—Simultaneously with the Quinquiennial International Telegraph Conference now being held at Paris a meeting of the Australasian Postmasters-General has been held at Adelaide, South Australia. About 10 days ago a letter was addressed to the Agents-General of the Australasian Colonies in this country by Sir John Pender, chairman of the Eastern Extension Telegraph Company, in which he made the most liberal offer, viz.: that from the beginning of next year the tariff should be reduced from 9s. 4d. to 5s. per word for one year by way of trial, on the condition that the colonies would bear one-half of any contingent loss, the company to bear the other half. In the end it has been agreed upon between the Eastern Extension Company and the Australasian Colonies that the experiment should be tried for one year upon the basis of 4½d. per word for ordinary telegrams. The only point that now remains to be settled is whether the Imperial Government will share the cost of subsidies, etc., payable by the colonies to the companies. As it has not done so hitherto, it is difficult to discover any valid reason why the Imperial Government should now share this cost unless the chance of imperiling an arrangement so advantageous to the mercantile community can be deemed a reason.

THE TELEPHONE.

The Bell Telephone Company reports a net increase of 469 instruments last month and of 1,124 during the past five months. The total number of instruments in operation by this company on the 20th ult. was 460,503.

Pittsburg, Pa.—The anti-induction telephone appliance is now on trial at the Eleventh Ward station house. Mr. Moorhead, the city electrician, says this is the first introduction of this appliance in the city. As the system is extensively used in the East and appears to work satisfactorily, there is little doubt that it will soon come into permanent use here.

The Orient Electric Company, with a capital of $100,000, has been organized under the Maine laws, to manufacture and sell the Blake makrophone or long distance sound transmitter, and all electrical appliances connected therewith. Its headquarters are at Portland, and its officers are: President, Robie Blake, Cornish; directors, Robie Blake, Cornish; Col. Edward Moore, Deering; J. J. Gerrish, Portland; treasurer, H R. Virgin, Portland; clerk, D. W. Scribner, Portland; counsel-general, Charles P. Mattocks, Portland.

THE ELECTRIC LIGHT.

Osage, Kan., will adopt the electric light.

Niagara Falls will be illuminated by electric light this summer.

Athens, Ga.—The Athens Electric Light Company, Ga., will probably enlarge its plant.

The Consumer's Electric Light Company, Chicago, have increased their capital stock.

Cullman, Ala.—The city has received a proposition for the erection of an electric light plant. The mayor can give particulars.

Camden, N. J.—Proposals are wanted until June 23 for lighting the streets of this city for a term of three years. Address the city clerk.

Hamburg, N. Y.—Extension and improvements will be made to the plant of the Hamburg Water and Electric Light Company at this place.

Keesville, N. Y.—The trustees have contracted with the Thomson-Houston Company to install an electric light plant in this village.

The Shelton, Conn., Gas Company has decided to move its electric light plant to Birmingham. A new and powerful dynamo will be added.

The Woodstock, N. B., Electric Light Company have found it necessary to duplicate their machinery, owing to the demand for power.

Middlebury, Vt.—The electric light station is nearly finished, the main wires are up and the plant will be all ready to illuminate by the 4th of July.

Hanford, Cal.—S. C. Lillis proposes to erect an incandescent electric light plant to cost $6,600, provided the citizens will guarantee sufficient support.

Riverton, Ala. (P. O. Chickasaw.)—An electric light plant is being erected by the Riverton Land Company, which also purposes operating a tramway.

The Holyoke (Mass.) Electric Light Company has been organized with a capital of $10,000. F. A. Wyman is president, and A. S. Palfrey treasurer.

The Waltham Watch Manufacturing Company is about to increase its electric lighting plant to a capacity of 4,000 lights, or about double what it is now.

The Halifax, N. S., Illuminating and Motor Company has purchased from the Royal Electric Company, of Montreal, a 100-arc light electric plant.

Halifax, N. S.—The Chandler Electric Light Company will be notified that when three years have expired their contract for lighting the city will be terminated.

Port Richmond, N. Y.—The citizens celebrated the recent initial performance of their electric lights by a grand parade and a supplementary display of fireworks.

Hamilton, Ont.—It is expected that the directors of the Hamilton Gas Light Company, at their approaching meeting, will decide to put in an electric light plant.

Lynn, Mass.—The arc electric lights began last Sunday night, according to the new schedule, to burn all night. The incandescents will be kept on the moon schedule.

The Chester (Pa.) Electric Light and Power Company is putting in a larger engine and two additional dynamos to meet the necessities of its rapidly increasing business.

Detroit, Mich.—An electric light company here indicates its confidence in the safety of its system by insuring the lives of its employés for $5,000 each against death by electricity.

Derby, Conn.—The directors of the Derby Gas Company are considering the advisability of moving their electric light station from Shelton to the Birmingham side of the Housatonic.

The Quincy, Ill., Gas and Electric Light Company has been incorporated with a capital stock of $400,000. The incorporators are: F. C. Crowley, W. C. Baine and Marion Pickett.

Peoria, Ill.—The Peoria Gas and Electric Light Company has been incorporated with a capital stock of $750,000. The incorporators are: F. C. Crowley, W. C. Baine and Marion Pickett.

Alameda, Cal., has given municipal bonds to the Jenney Electric Light Company, of Indianapolis, to the amount of $23,000 in payment of the balance for the lighting plant in that city.

Milwaukee, Wis.—Proposals are wanted until July 1, for furnishing, erecting, and maintaining 300 or more electric lights, for a term of three years. Address Fred. F. Wilde, Deputy Comptroller.

The St. Thomas, Ont., Gas Company have purchased a Westinghouse alternating incandescent electric plant, which includes a 750-light dynamo. Two hundred lights have already been installed.

The Binghamton, N. Y., Electric Light and Power Company has filed articles of incorporation with the Secretary of State. The capital stock of the company is $200,000, divided into 2,000 shares.

The Taunton, Mass., Electric Lighting Company has let the contract for its new station to Mr. Frank D. Williams. The company has just received a new 50-light dynamo with the Adams-Brush double carbon lamps.

Rockaway, N. Y.—The Rockaway Electric Light Company has been incorporated, with a capital of $100,000, to establish an electric light plant here. Jos. A. Taylor, of Plainfield, N. Y., is an incorporator, and may be addressed.

Corning, N. Y.—The contract for lighting the streets of this city by electricity for a term of five years, has been given to the Corning Gas Light Company, which will erect an electric light plant for this purpose, and will probably light many residences also.

Greenville, S. C., has a railroad and a dummy street car line, and has just granted a franchise to a company to install a $300,000 electric light and power plant. The franchise stipulates that an electric street railway is to be put in operation within six months.

Dubuque, Ia.—The ordinary course of events has been reversed in the case of the Dubuque Street Railway Company, which, after running electric cars for some time, has just asked and been granted an electric light franchise. Usually the light comes before the motor.

Clower & Harris, of Dallas, Tex., have closed a contract with the Waxahachie (Tex.), Electric Light Company, for a complete Heisler plant, to supply light for two hundred and fifty 32 c. p. lamps. The work will begin as soon as the material can be got on the ground.

Worcester, Mass.—The Common Council, at its meeting last week, appointed a committee to investigate the advisability of the city maintaining its own electric light plant. The committee is directed to report the cost of construction and maintenance of a plant equal to the needs of the city.

Apollo, Pa.—The Apollo Iron and Steel Company has decided to illuminate its works by electricity. The company has been prompted to make this improvement by reason of the great increase in its business, which necessitates working at night. The new arc lighting system of the Westinghouse Electric Company will be used in lighting the plant.

Montreal, Can.—The Economic Light and Manufacturing Company is applying for incorporation with a capital of $10,000, for the purpose of carrying on business in all appliances, apparatus, etc., for lighting purposes The names of the applicants are: Messrs. Allan Cameron, Geo. H. Patterson, Wm. H. Olive, Theodore V. R. Brown, Nelson V. Smith, Dr. D. E. Gurd, John L. Caverhill and John F. Mackie.

In Texas.—Another town in the Lone Star State has pushed down the breastworks of barbarism and joined the procession in the progress of modern improvements by introducing the electric light within its precincts. This time it is Cleburne, Tex., whose enterprising citizens have formed an electric light company, and also made a contract with the Westinghouse Electric Company for one of its 500-light alternating current machines.

Kingston, Jamaica.—A Thomson-Houston electrical expert, writing from this place, where he is stationed, says that the masons are fast completing the power station of the Jamaica Electric Lighting Company. Meanwhile, he, with a force of linemen, is kept very busy wiring churches, halls and residences. The Kingston plant is a good one and will pay well. Mr. Nielly is enthusiastic over the many beauties of Jamaica, where he will remain for at least six months.

The Sunbeam Incandescent Lamp Company, corner Randolph and Canal streets, Chicago, is gratified with the excellent reception given the Sunbeam lamp by the various companies that are using it, and the high record for efficiency which the lamp is building up. It is also gratifying to note that the larger lighting companies are not influenced so much by a drop in the price of the lamp as by a drop in the economical results shown, and that they are willing to pay a high price for a lamp of known high efficiency.

Braddock, Pa.—The Citizens' Electric Company has let contracts for the erection of one of the finest electric light stations in western Pennsylvania. The structure will be 40 feet wide by 74 feet long, and will be built of brick. The company intends to add to its present plant two Sterling boilers and one 125 h. p. Russell engine. The dynamo capacity of the station will be increased by one 750-light Westinghouse alternate current machine and a Thomson-Houston arc machine for 50 lights. The work is to be completed by August 1.

The Newark (N. J.), Electric Light and Power Company has been compelled to make some important improvements and enlargements in its incandescent plant. This was necessitated by the great increase in the demand for the light made upon the company by its many customers. The corporation has been very successful in the establishment of the electric light plant, which has been on a paying basis from the very day it was organized. The company at the start adopted the Westinghouse alternating current system of electric lighting. Apparatus of a capacity of 2,250 16 c. p. lamps was installed at the plant at first, and the last increase made the total capacity of the machinery 3,750 lights.

The Largest Isolated Plant in the World will be that which is soon to illuminate Madison Square Garden, New York City. Six thousand 16 c. p. incandescent lamps will be used in the three auditoriums and foyers, and the stalls in the immense cellars. It was originally the intention of the management to use but 3,600 lamps, and a contract for that number was let to Mr. H. A. McLean, of the Edison Illuminating Company, 43? Fifth Av. As the installation was being carried out, however, the managers continually called for more lamps to light up the dark places; there may be even more needed, for the main auditorium is an immense one, being 300 feet long by 200 wide and 60 high. The dynamos are installed under the Fourth Av. end, and are belted to two 150 h. p. New York Safety Steam Company's auto-

matic high-speed engines. The diffusion of light in the vast amphitheatre is admirably arranged. Beginning at the dynamo room, Habirshaw feeders of 400,000 circular mills each and 400 feet long will run through the basement to the centre of the amphitheatre, whence the distribution is made to light this part of the building; these feeders are brought up against the brick foundation wall of the amphitheatre, where a large switch-board will control all the circuits. Three other feeders, each 300,000 mills and 700 feet long will run to the Madison Av. end of the garden, lighting the theatre and concert garden. Supporting the roof of the amphitheatre are six main and 16 radial trusses; upon each main truss depending from the lower side, are 1,100 lamps, and upon each radial truss, similarly located, are 26 lamps. The three-wire system is used throughout; each of the large trusses has four circuits, and the radials two; the object being to maintain light distributing circuits. Clusters will be distributed freely, one of 50 lights being placed at the junction of the radial trusses at each end of the amphitheatre; small ones on the face of the columns supporting the galleries, one of 300 lights at each end of the large skylight, and one of 600 lights in the centre of the ceiling. Distributing boxes are placed in the middle and at the ends of each gallery to maintain the circuits for the brackets, and at four points on the promenade around the top of the room, to maintain the circuits on the trusses. Twenty-two thousand feet of interior conduit is used in carrying the conductors throughout the building, and more than 20 miles of Habirshaw wire are employed. In the basement special feeders and switchboards connect with the street mains, and when all the work is completed the street circuit can be switched in or out at a moment's notice. No light but the electric will be used in the building. Wm. B. Hadley, the general electrician of the Edison Illuminating Company is superintending the entire installation.

APPLICATIONS OF POWER.

Put-in-Bay, O., is going to put in an electric street railway.

Hayward, Cal.—Work has begun on the electric street railway.

Great Falls, Montana.—The electric railway is being extended to Giant Spring.

Hudson, N. Y.—The line is being graded for an electric railway, which is expected to be in operation about the 1st of August.

Victoria, B. C.—The National Electric Tramway Company will extend its line to Esquimault, at a cost of $85,000.

Dallas, Tex.—A Galveston syndicate has petitioned the authorities for a franchise to build an electric motor railway in this city.

Kittanning, Pa.—A company has been organized to build an electric railway from this place to Ford City, a distance of seven miles.

Hamilton, Ont.—The directors of the Hamilton Street Railway Company are said to be considering the question of adopting electricity.

St. John, N. B.—A Sprague motor for the proposed electric street railway at this place is being constructed at the Edison factory at Sherbrooke, Que.

Granville and Newark, O.—The new electric railroad between these places is being constructed, and the contractor promises to have the line ready for business in July.

Chattanooga, Tenn.—The trial trip over the Boyce street electric line was made without an incident to mar its success. The track was in splendid condition, and the trolley wires worked to perfection.

St. Joseph, Mo.—It is rumored that the People's Electric Street Railway Company will soon pass into the hands of Kansas City investors. The company operates about 16 miles of electric road besides a lighting plant, each of which yields a good profit.

The Usual Thing.—The first electric car that ever moved on an Indianapolis street started out on a six miles' trial trip last Friday night, and satisfied all concerned that the Thomson-Houston Company had more than fulfilled its contract. The six miles were covered in twenty minutes. The line is now formally opened, and in full operation.

Toronto, Ont.—The engine in the Barber & Ellis Company's establishment having broken down, an "Eddy" motor, which had done duty for a section of the works on night shifts, was brought into requisition, and performed so satisfactorily the work of driving the machinery on the entire three flats, that the company is seriously contemplating the adoption of electricity as a motive power for the future.

Saginaw, Mich.—The Mayor, in his annual address, made the following reference to the Rae system in that city: "I believe we did a wise act when we granted the street railway company the right to change their system to the electric power. Rapid transit is demanded by the public, and in giving the right to the company to change their motive power from horses to electricity, we enabled the company to give better communication to all parts of our city."

Allegheny, Pa.—It is thought that shortly there will take place a formal consolidation of the Pittsburg, Allegheny & Manchester and the Pleasant Valley street railway lines. Things have been working that way recently, and the capitalists interested in both lines seem to think such a move would be wise. A consolidation of this sort would virtually have a monopoly of the street car business in the City of Allegheny, and there should be big money in it.

Kansas City, Kan.—One of the most important franchises recently granted in this city was that to the Enright-Thayer Company to build and equip seven miles of double track electric railway. The overhead system will be adopted. Ten motor cars will be operated, with trailers. The road will cost $300,000. The line will extend through Argentine, Amourdale, Kansas City, Kan., to Kansas City, Mo., crossing a long viaduct. The right of way has been secured, and everything is in readiness excepting the franchise for two miles in Kansas City, Mo., but no trouble is anticipated at this point.

The Thomson-Houston Motor Company has issued a little tract setting forth the advantages of electric tramways for mills and manufacturers. Electric traction has been gradually working itself into this department of freight service with great advantage to the users, and in nearly every place where it is employed it has given the greatest satisfaction. The Thomson-Houston Company practices what it preaches in this respect; for nowhere in the country is to be found a more general or effectual use of the electric motor in factory service than in the great Lynn establishment.

Kansas City, Mo.—Mr. Wm. B. Knight, 200 West Sixth street, has closed a contract with the Kansas City & Blue Valley Railway Company for the entire work of building their line. The road will be about 2¼ miles long, double track, overhead wire, single centre pole construction, and first class in every respect. It will be equipped with Thomson-Houston electrical apparatus with six cars having double 15 h. p. motor trucks under each. The line has a maximum grade of six per cent. which is continuous for a distance of 2,300 feet. Mr. Knight expects to get the road completed and turned over to the Company in September.

PERSONAL.

Mr. Harry Z. Cobb, superintendent of cable laying for the Cobb Vulcanite Wire Company, of Wilmington, Del., sailed for Europe on June 14 for the benefit of his health.

Mr. Albert Schelble, formerly with the Brush Swan Lamp Company, is now connected with the Great Western Electrical Supply Company, Chicago, in the capacity of salesman.

Mr. Clifford Holbrook, vice-president of the Canton Steel Roofing Company, Canton, O., visited friends in Chicago this week while en route West on a business trip for his company.

Mr. D. A. Andrews, Jr., of Pettingell, Andrews & Co., Boston, is stopping at the Auditorium, Chicago, while combining business with pleasure. Mr. Andrews is accompanied by his mother, who is quite an admirer of the enterprise and push exhibited in Chicago.

Mr. A. W. Field, late with the Thomson-Houston Electric Company, railway department, and formerly general agent for the Frank H. Andrews Car Wheel Company, has connected himself with the American Steel Car Wheel Company, and will give his personal attention to the sale of wheels for street railway service.

Major J. C. Paul, late general manager of the Woodruff Sleeping Car Company, and superintendent of equipment of Pullman Car Company, has been appointed vice-president of the American Steel Car Wheel Company, of Boston, and will have the general charge of the sales department, with his office at 115 Broadway, New York.

A Wedding.—Mr. Hubert S. Wynkoop, the electrical engineer of the Chicago office of the United Edison Company, and Miss Sarah M. Zabriskie will be married on Tuesday next, June 24, at the residence of the bride's parents, in Mount Vernon, N. Y. Mr. Wynkoop's many friends in New York, Chicago and Minneapolis will join in wishing him all possible happiness.

Mr. Elmer P. Morris, president and general manager of the Novelty Electrical Supply Manufacturing Company of Cincinnati, O., has been in Chicago this week arranging for the handling of his supplies by local houses. The remarkable growth of their business is worthy of note, especially in the line of electric railway supplies, the company having made a specialty of railway material from the beginning. Among their specialties is the Morris improved combination pole top, the Morris insulated trolley wire hanger, trolley wheels for any system, loop circuit breaker, arc lamp, windlass, etc.

MISCELLANEOUS NOTES.

London, Ont.—A display of electrical apparatus is to be one of the prominent features of the Western Fair in September.

Montreal, Can.—The Royal Electric Company have recently installed an electric plant in Messrs. Ira Gould & Son's flouring mills.

The Hine Eliminator Company have received an order for two of their largest sized eliminators for the Halifax, N. S., Illuminating and Motor Company.

The Cobb Vulcanite Wire Company, of Wilmington, Del., have received an order from the Brush Electric Light Company, of Buffalo, for 23,000 feet of subway and 150,000 of cable.

The Keegans-Milne Company have been appointed Canadian agents for Crompton & Co., Lim., Chelmsford, Eng., for the sale of their electrical appliances. The company's headquarters are in Montreal.

The Gibson Gas Fixture Works, 1426 Callowhill street, Philadelphia, are not controlled by any combination or trust, do no retail business, and estimate on no private plants. They deal exclusively with the trade.

The Baltimore Ventilating & Motor Company has been incorporated at Baltimore, Md., by L. H. Durling, C. A. Vaile, L. F. Young and others, to manufacture and sell ventilating fans, blowers and motors. The capital stock is $50,000.

The Norton Electric Boot Blacking and Novelty Manufacturing Company have been incorporated at Waukegan, Ill., to manufacture a boot blacking machine. Capital stock, $1,000; incorporators, F. G. Norton, H. F. Norton and J. F. Lindsay.

A. H. Whitney & Sons, of Philadelphia, Pa., are said to have the largest car-wheel works in the country. They are now making a specialty of electric street railway wheels, and have furnished the Thomson-Houston and other large companies with a number of heavy consignments.

The Cleveland Electric Motor Company are doing an extensive business in arc motors. They are sending a large number to the Western States, and are kept busy installing them in New York and vicinity. They have become very popular by their special mode of conducting business.

The Next Convention of the National Electric Light Association will be held at the Stockton Hotel, Cape May, N. J., on August 19, 20 and 21. The Executive Committee of the Association held an important meeting on Monday evening last at the Electric Club rooms, New York.

The Carpenter-Nevins Electric Heating Company has been incorporated at Minneapolis, Minn., with a capital stock of $300,000. The highest amount of indebtedness at any one time is limited to $10,000. The incorporators are: F. W. Nevins, Charles G. Carpenter, M. F. Schofield, John W. Kelly, L. Kimbell and Robert T. Lang.

The United Electrical Equipment Company, to sell all kinds of electrical machinery and to install light and power plants, has been incorporated in Philadelphia, with a capital of $100,000. The incorporators are: Wm. J. Merrill and Henry N. Almy, of Philadelphia; Charles R. Eberle, of Williamsport, Pa.; B. Marsden Vaughan, of Wilmington, Del., and Frank C. Meeser, of Camden.

Rahway, N. J.—The Interior and Underground Electric Insulating Company has filed articles of incorporation in the Union County courts, with a stated capital of $1,000,000. The company will conduct its business in Jersey City, Rahway and New York. Its stockholders are: John Weaver, of Rahway; and Frank Cochran and Waldo G. Morse, of New York. The plant is to be located at Rahway.

Chadbourne, Hazelton & Co., Philadelphia, have just issued a circular setting forth the merits of the Wenstrom dynamos and motors, of which they are the sole agents. The Wenstrom Company has entered the field with two very important adjuncts to successful operation—a strong financial backing and an excellent machine; and the selection of the present agents is a sufficient guarantee that business energy will not be lacking.

An Interesting Decision was rendered last week in the Kentucky Court of Appeals in the case of Chapman against the Western Union Telegraph Company. A message sent to Chapman informing him of the approaching death of his father had not been delivered by the telegraph company, and the court decided that the company was liable for damages, both to the feelings and financial interests of Chapman, by failure to use all due diligence to deliver the dispatch.

A dispatch from Albany, N. Y., says that the Westinghouse Electric Company intends to prevent the use of its alternating current dynamo for electrical execution purposes in the New York State prisons by taking out a writ of replevin, claiming that it still retains a proprietary interest in the machines it sells to its customers. The company will seek to restrain the State from using its machines on the ground that Harold P. Brown illegally and fraudulently obtained possession of them by collusion with its customers.

The Fattrell Insulated Wire Company, of Philadelphia, have issued a small volume which they have called a "Hand-Book for Electricians," and which is well worthy its title. Into its few pages are packed many valuable working points and some very important tables. The company have not neglected inserting some data concerning their wire, which, indeed, may well be examined by electricians. More than a year ago they laid a section of their cable in the sand on the shore of South Carolina, and it is working satisfactorily to-day.

The Lane & Bodley Company, Cincinnati, O., during the week ending June 6, received orders for one 500 h. p. high pressure Corliss engine for the Des Moines, Ia., Electric Street Railway Company; one 500 compound condensing engine, with surface condenser, for the Cincinnati Electric Light Company; and one 400 h. p. for the Evansville, Ind., Gas and Electric Light Company. Three such orders in one week show not only the demand for engines by electric light and power companies, but also the enviable reputation of this company, which has been in the business for half a century.

The Ball Engine Company, of Erie, Pennsylvania, have furnished engines for thirty-six different electric railways, aggregating 9,700 horse power. Among orders recently received are the following: Elgin Street Railway Company, Elgin, Ill., two 150 h. p. tandem compound engines; Johnstown Passenger Railway Company, Johnstown, Pa., three 150 h. p. engines; Winston Electric Railway Company, Winston, N. C., two 150 h. p. engines; Rockford Street Railway Company, Rockford, Ill., one 150 h. p. tandem compound engine; Binghamton Street Railway Company, Binghamton, N. Y., one 150 h. p. engine; South Side Land Improvement Company, Richmond, Va., one 100 h. p. engine; Rochester Street Railway Company, Rochester, N. Y., three 500 h. p. triple expansion engines; three 150 h. p. standard engines, and one 60 h. p. standard engine; Belt Line Electric Railway Company, Port Townsend, Wash., one 300 h. p. double compound engine; Southern Railway Company, St. Louis, Mo., five 150 h. p. tandem compound engines.

Some interesting tests of the tensile strength of tempered copper wire have recently been made by G. W. G. Ferris & Co. engineers, of Pittsburgh. The tempered copper, it will be remembered, is a new product of rather remarkable process, manufactured by the Eureka Tempered Copper Company, and as it has been strongly recommended for electrical purposes, the result of the tests will be of some little interest to readers of THE ELECTRICAL WORLD. They are subjoined in full, and it will be seen from them that the tensile strength of the tempered material is nearly double that of ordinary copper wire.

TEMPERED COPPER.

Area	Original	.0487	.0487
	Fractured	.0165	.0255
	Per cent. reduction	66.12	47.64
Max. load per sq. in.		64,480	64,480
Extensions	8 in.	.24	.20
	1 in.	.20	.15
	Per cent. 8 in.	3	2.5
	Per cent. 1 in.	20	15

COMMON COPPER.

Area	Original	.0511	.0511
	Fractured	.0152	.0161
	Per cent. reduction	70.25	68.49
Elastic limit per sq. in.		27,020	27,790
Max. load per sq. in.		34,640	34,840
Extensions	8 in.	2.58	2.84
	2 in.	.88	.86
	Per cent. 8 in.	32.25	35 5
	Per cent. 2 in.	44	43

BUSINESS NOTICES.

Steam Pipe and Boiler Coverings.—The H. W. John's Manufacturing Company, 87 Maiden Lane, N. Y., make a specialty of applying their coverings in any part of the United States. Send for estimates.

Walter E. Crane, Minneapolis manufacturer of the Baker oil filter, is having many calls from all parts of the country for this superior device, his business having doubled in the past two months. The numerous tests to which the filter is constantly subjected show the oil to be perfectly filtered, and many very favorable voluntary comparisons of its worth have been received, with no unfavorable ones.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas-lighting batteries if accidentally grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company, of Syracuse, N. Y., No. 115 South Warren street.

Storage Batteries.—Mr. A. G. Mercer, treasurer of the Waterloo Electric Company, Waterloo, New York, in a personal letter, says: "For seven months we have been using 126 of the 15 L type of the Electrical Accumulator Company's cells, and have had no trouble whatever with the battery; have not paid one cent for repairs, and supplied current to our customers without intermission since we first switched the battery into circuit. We have a 3 h. p. C. & C. motor in a printing office on the battery circuit, that has given perfect satisfaction, and I think a storage battery is of material advantage to all small stations."

BUFFALO, May 14, 1890.

Alfred Short, President Eureka Tempered Copper Company, North East, Pa.:

DEAR SIR: Some time, about eight months ago, we began the use of tempered copper for commutator segments on the Brush machine, and we have had remarkable success with its use. We find that they wear about three times as long as ordinary segments made of copper. We have tried the experiment of using tempered copper for brushes and beg leave to report the result: The first of March we put a set of brushes on a dynamo and they were not trimmed until April 17. This is a remarkable showing, and you may count upon us as stanch advocates and constant users of tempered copper in this line of our business.

Yours very truly, the Brush Electric Company.

C. R. HUNTLY, General Manager.

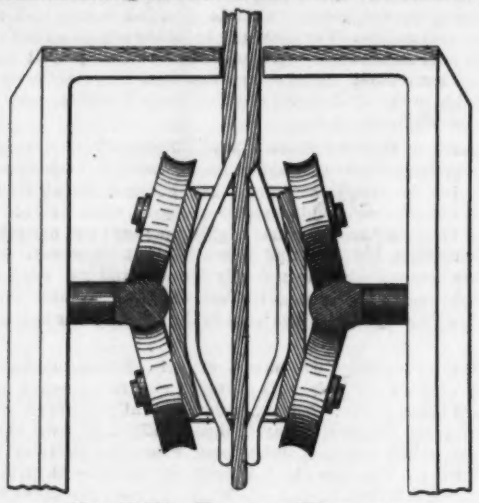
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED JUNE 10, 1890.

11,083. (Reissue) Electric Railway; Walter H. Knight, of Newton, Mass. Application filed May 14, 1890. The combination, in an electric railway, of a bared supply conductor connected to one pole of the source of electrical supply and a return in circuit with the other pole, but electrically disconnected from the first named conductor except through the motors traveling over the railway, with a series of permanently located detecting devices, each operated by the current upon a different section of the supply conductor to indicate the location of a fault thereon.

11,084. (Reissue) Electric Railway; Walter H. Knight, of Newton, Mass. Application filed May 14, 1890. The combination of a slotted conduit, a conductor inclosed therein, a contact device adapted to travel along the conductor, and an insulated conductor extending into the conduit and having a detachable connection with the contact device.

429,596. Galvanic Battery; John Beattie, Jr., of Fall River, Mass. Application filed Jan. 3, 1890. In a galvanic battery a zinc element having all of its surface except the bottom treated



No. 11,084.—ELECTRIC RAILWAY.

to prevent chemical action, in combination with a cup whose bottom only is porous.

429,599. Electric Annunciator; James D. Bishop, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Feb. 3, 1890. The combination, with the shell of soft iron, of the coil placed therein, and a pivoted armature magnetically connected with the shell and extending through the coil, whereby on sending current through the coil the free end of the armature is moved to operate a signal device.

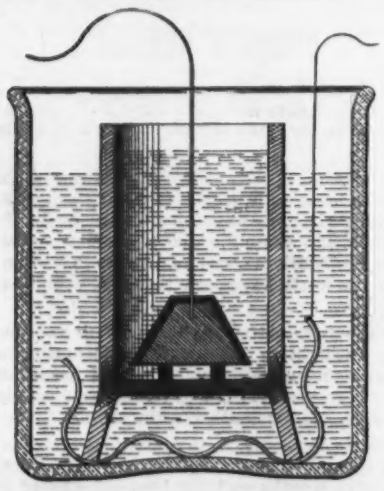
429,608. Manufacture of Incandescent Electric Lamps; Richard N. Dyer, of New York, N. Y. Application filed June 5, 1884. The method of manufacturing incandescing electric lamps having loop conductors, consisting in subjecting the loop conductors to strain during the exhausting process by weights hung to them, removing such weights from the lamp globes while the lamps are still connected with the pumps and then sealing off the lamps.

429,687. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Electric Car Company of America, of same place. Application filed Dec. 1, 1887. In an electric railway a car body for passengers, supported on a fixed truck at one end and a pivoted truck at the other end, over which it extends, in combination with an electric motor supported on the pivoted truck under the car body and mechanically connected with the axle of the truck.

429,703. Galvanic Battery; Jose Siliceo, Jr., of Mexico, Mex. Application filed Feb. 19, 1887. Patented in Mexico Dec. 29, 1884. In an electric battery, the combination with a jar, of a porous cup having a conical-shaped bottom.

429,727. Lightning Arrester; Oliver J. Dodge, of Liverpool, County of Lancaster, England. Application filed May 22, 1889. As a lightning protector a series of two or more air gaps arranged one after the other on the line circuit with self induction coils between, whereby the great portion of the high tension electricity is shunted at the first gap, the greater portion of the remainder at the second, and so on.

(1) 429,729. (2) 429,732. Generator for Electrically-Reciprocated Tools. (3) 429,730. (4) 429,731. Electric Drill System; Harry N. Marvin, of Syracuse, N. Y. Ap-



No. 429,596.—GALVANIC BATTERY.

plications filed March 19, 1890. (1) and (2). The combination with a drill or a reciprocating tool having two opposing magnetizing coils, of a source of continuing currents connected with the coils, and a source of rising and falling electromotive force of opposite sign or direction included in or connected with the two drill circuits, respectively. (3) and (4). The invention consists in a transformer adapted to convert direct or continuous currents of a given potential into pulsating currents of the same or another potential, which is to be connected to any desired point in an electric circuit, and which may be used to operate one or any desired number of reciprocating drills.

429,735. Multiplex Telegraphy; Francis Jarvis Patten, of New York, N. Y., Assignor to J. M. Seymour, of Brick Church, N. J. Application filed Jan. 10, 1890. A system of synchronous multiplex telegraphy, consisting of a single main line, including an alternating source of electricity and all of a series of synchronizing relays, in combination with a series of independent signaling lines connecting independent pairs of stations, a pair of distributers and electric motors for each signaling line, with independent multiplex sets of signaling and receiving apparatus for each signaling line and electrical connections between the synchronizing relays and pairs of distributers, whereby synchronism is maintained and signals may be sent.

429,736. Dynamo Electric Machine; Richard Pfund, of Brooklyn, N. Y. Application filed Feb. 24, 1890. The combination, with a dynamo electric machine, of a transformer whose primary coil is mounted to rotate synchronously with the armature of the dynamo.

429,745. Electric Connection; Charles J. Van Depoele, of Lynn, Mass. Application filed Aug. 15, 1889. A circuit of conductors, composed in part of the rails of a railway track, said rails being united at their extremities by strips of non-corrosive metal, as zinc or tin, rigidly clamped against the metal of which the rails are composed.

429,746. Electric Railway Motor Truck; Charles J. Van Depoele, of Lynn, Mass. Application filed Aug. 15, 1889. The invention relates to electric railway cars, and more especially to certain improvements in trucks supporting the motors for propelling the cars and in the means and mechanism for sustaining the motors upon the truck.

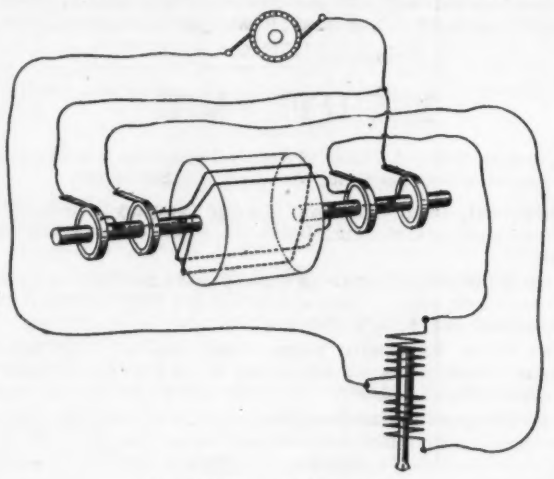
(1) 429,747. Telpher System; (2) 429,981. Electric Railway Conductor System; Charles J. Van Depoele, of Lynn, Mass. Applications filed (1) May 13, 1887; (2) April 9, 1890. (2) An electric railway conductor system comprising sectional working conductors connected at their ends to adjacent sections by an insulating support, and electrically connected to each other by a fusible connection which spans the insulating support. (1) In a system of telpherage, the combination of a cable, a motor car, and one or more freight vehicles arranged to travel thereupon, the supporting wheel of the vehicle and those on the motor car being mechanically connected.

429,751. Electric Meter; John H. Barnard, of Asheville, N. C. Application filed April 4, 1890. The invention is an improvement in electrical meters for general use in electrical systems for indicating and recording the current distributed or used in any given circuit or branch thereof.

429,787. Electric Arc Lamp; Carl Coerper, of Ehrenfeld, Germany, assignor to Helios Actien-Gesellschaft fur Electrische Licht und Telegraphenbau, of same place. Application filed Jan. 25, 1889. Patented in England Dec. 14, 1888. In an electric arc lamp, the combination, with a solenoid, of a core in the same, a pivoted lever connected with the core, an air brake connected with the opposite end of the said lever, a connecting rod also connected with the lever, a rock frame connected with the connecting rod, and a train of gearing for operating the carbon holders, which train of gearing is mounted on the said rock frame.

429,801. Telephone; William Vogel, of Chicago, Ill., Assignor of three-fourths to Gary G. Calkins and Adolph Gray, of same place. Application filed Aug. 19, 1889. A telephone embracing a magnetized strand or core extending between the transmitting and receiving points or stations, and transmitting and receiving devices comprising vibrating armatures located adjacent to the ends or poles of the magnetized strand or core.

429,815. Cable Terminal; John C. Reilly, of Brooklyn, N. Y., Application filed Nov. 18, 1889. The combination with a cable terminal of cast or molded insulating material in two sections, one or more ribs or strips upon the exterior surface of one section



No. 429,729.—GENERATOR.

of pipe united to a perforated end of said section, a series of insulating conductors having a sheathing united to the pipe section and electrical connections between the connecting posts and conductors.

429,817. Electric Burglar Alarm; Harold C. Schubert, of Chicago, Ill., Assignor to Louis K. Curlett and James Rose, of same place. Application filed March 8, 1890. The combination with a door frame and door, a keeper on the frame and a lock on the door, an electric circuit, including an alarm, a spring in the keeper connected to the wires of the circuit, a metallic shoulder on the keeper, also connected to the wires of the circuit, and an automatic circuit breaker, consisting of a metallic plate on the frame interposed in the circuit and a coincident metallic spring on the door, also interposed in the circuit.

429,825. Electric Regulator; Edmund Wagemann, of Little Rock, Ark., Assignor of six-sevenths to John D. Adams, Oscar Davis, John W. Davis, Horace G. Allis and John B. Jones, all of said place. Application filed Sept. 11, 1889. In a regulator for a dynamo, the combination of a field magnet pole provided with a cavity at that point nearest the armature of the dynamo, a core or plunger of iron fitting loosely in the cavity, sub-coils of the field magnets, cut out contacts for the sub-coils attached to movable rods, and connecting rods pivoted both to the first named rods and to the said plunger.

429,887. Galvanometer; Arthur E. Colgate, of New York, N. Y., Assignor to F. G. Otto & Sons, of same place. Application filed March 14, 1890. The invention consists in combining with an inner cylindrical stationary core and with an outer magnet or set of magnets straddling the core an intermediate movable core or set of coils, which is connected with the pointer or index finger of the instrument.

429,895. Galvanic Battery; George H. Felt, of New York, N. Y. assignor to the Felt Electrical Company, of same place. Application filed Nov. 13, 1889. In a galvanic battery, an insulating cell or jar and a cathode of copper plates joined centrally and bent apart at the edges, the length and arrangement of the plates being such that their ends press against the sides of the jar and hold the cathode in place.

429,896. Electrode for Galvanic Batteries; George H. Felt, of New York, N. Y., assignor to the Felt Electrical Company, of same place. Application filed Nov. 15, 1889. An electrode for galvanic batteries, consisting of a body of metal coated with an amalgam of the same metal, combined with aluminium and mercury.

(1) 429,897. Porous Cell for Galvanic Batteries; (2) 429,898. Solution for Galvanic Batteries; George H. Felt, of New York, N. Y., Assignor to the Felt Electrical Company, of same place. Applications filed (1) Jan. 4, 1890. (2) Jan. 13, 1890. (1) A porous shell having a dome-shaped bottom and a tube leading from the top of the dome through the cell. (2) A depolarizing solution for galvanic batteries, consisting of liquid sulphate of aluminum or other aluminum compound combined with a solution of salt or salts of mercury in presence of metallic mercury.

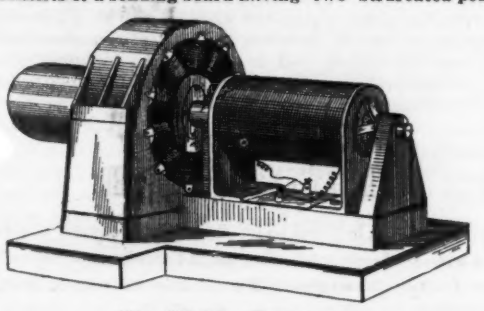
429,899. Railway Signal System; Leroy B. Firman, of Chicago, Ill. Application filed April 15, 1889. The railway signal system, comprising the ordinary main circuit used for general telegraph purposes, and a train dispatcher's station with a series of signal or semaphore stations, a transmitting and receiving instrument at the train dispatcher's station included in the main circuit, and a receiving instrument, a semaphore, and an automatic signal box included in the main circuit, and having an operating arm connected with a semaphore and operated thereby at each semaphore station.

429,912. Secondary Battery; Carl Hering, of Philadelphia, Pa. Application filed April 15, 1890. An accumulator consisting of positive and negative plates of active material each with a conducting sheet, the plates of opposite polarity being separated from each other by non-conducting sheets, the series of plates and sheets being secured together by pressure, and the plates being separated from each other only by the thickness of the conducting and non-conducting sheets.

429,913. Secondary Battery; Carl Hering, of Philadelphia, Pa. Application filed April 15, 1890. In a Secondary Battery, a series of alternate composite plates or layers of active material having a conducting sheet in contact with each composite plate or layer and a non-conducting sheet between each two adjacent composite plates or layers of different polarity, such composite plate or layer being composed of a number of flat rings approximately juxtaposed, the corresponding rings in all the layers being in line with each other.

429,914. Secondary Battery; Carl Hering, of Philadelphia, Pa. Application filed April 5, 1890. An accumulator, consisting of a pile of plates of active material, conducting sheets, and non-conducting sheets placed horizontally and serially superimposed and juxtaposed.

429,982. Mechanical Telegraph Instrument; Eugene R. Waterhouse, of St. Louis, Mo., Assignor of one-half to Hart A. Fisher, of same place. Application filed July 9, 1889. The invention consists of a sonding board having two bifurcated pedestals



No. 429,736.—DYNAMO.

carrying the actuating lever and armature arm, the actuating lever being pivoted to armature arm at its inner terminal, the pivotal connections arranged to multiply the rapidity of the stroke of the tappet.

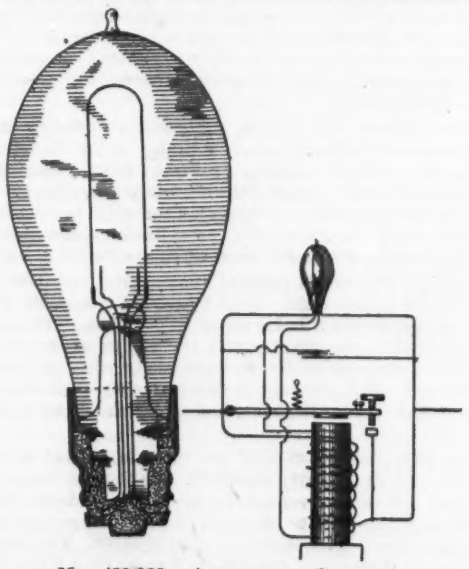
430,010. Underground Electric Conduit; Henry Flad, of St. Louis, Mo., Application filed Sept. 18, 1889. In an underground electric conduit, the combination with substantially air tight enveloping pipe or pipes for conducting electric wires, of a compressed air pipe or supply chamber in communication with the enveloping pipe or pipes for maintaining a suitable pressure within the enveloping pipe or pipes.

430,025. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor, to the Thomson-Houston Electric Company, of Connecticut. Application filed Sept. 13, 1888. In an electric railway, the rails and road bed, in combination with a conduit arranged close to one of the rails, an electric conductor within the conduit, an electrically propelled vehicle, and a laterally movable current collecting device movable with relation to the vehicle and extending into the conduit.

430,058. Method of Separating Ores Magnetically; Clinton M. Ball, of Troy, N. Y., and Sheldon Norton, of Hokendauqua, Pa., Assignors to the Magnetic Separator Company, of Watervliet, N. Y. Application filed Oct. 16, 1889. The invention consists in passing the ore and gangue through a magnetic field, and when emerging therefrom subjecting the adhering ore to centrifugal action, while interposing a deflector in the tangential path of the ore to separate the less magnetic from the more highly magnetic portions of the separated product.

430,054. Switch Board; Johan M. Anderson, of Boston, Mass., Assignor of One-Half to Albert Anderson, of same place. Application filed March 20, 1890. The invention consists in the combination, with a plurality of switches, each consisting of a movable hub provided with a conducting and insulated surface, contact brushes co-operating therewith, and a handle to move the hub, of a gear for each switch provided with a sleeve, a locking device to secure the handle to the said sleeve, and a rack bar to remove the gears, whereby movement of the gear may impart movement to the hub.

430,060. System of Electrical Distribution; Edward M. Bentley, of Boston, Mass., Assignor to the Thomson-Houston Electric Co., of Connecticut. Application filed April 2, 1890. The combination, in an electric circuit, of a group of translating devices in multiple arc with a second similar group, and a transla-



No. 430,096.—AUTOMATIC CUT-OUT.

ting device in multiple arc with one of the groups adapted to transfer the surplus energy to the main machine.

430,075. Galvanic Battery; Charles A. Hitchcock, of North East, Assignor of one-half to Samuel A. Davenport, of Erie, Pa. Application filed Dec. 16, 1889. The combination, in a galvanic battery, of a zinc cup and an isolated hollow carbon cylinder therein, filled with a depolarizing agent, and having its top and bottom closed or sealed, with an exciting agent filling and occupying the space between the outside of the carbon cylinder and the zinc cup in which it is located.

430,096. Automatic Electric Cut-Out; Montgomery Waddell, of New York, N. Y., Assignor to the Waddell-Entz Electric Company, of same place. Application filed April 21, 1887. An incandescent electric lamp provided with two normally idle wires extending between the sides of the looped filament, in combination with cut-out devices operated by the passage of an abnormal current in either or both of the wires.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1836—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co., Ltd., Times Building, N. Y.

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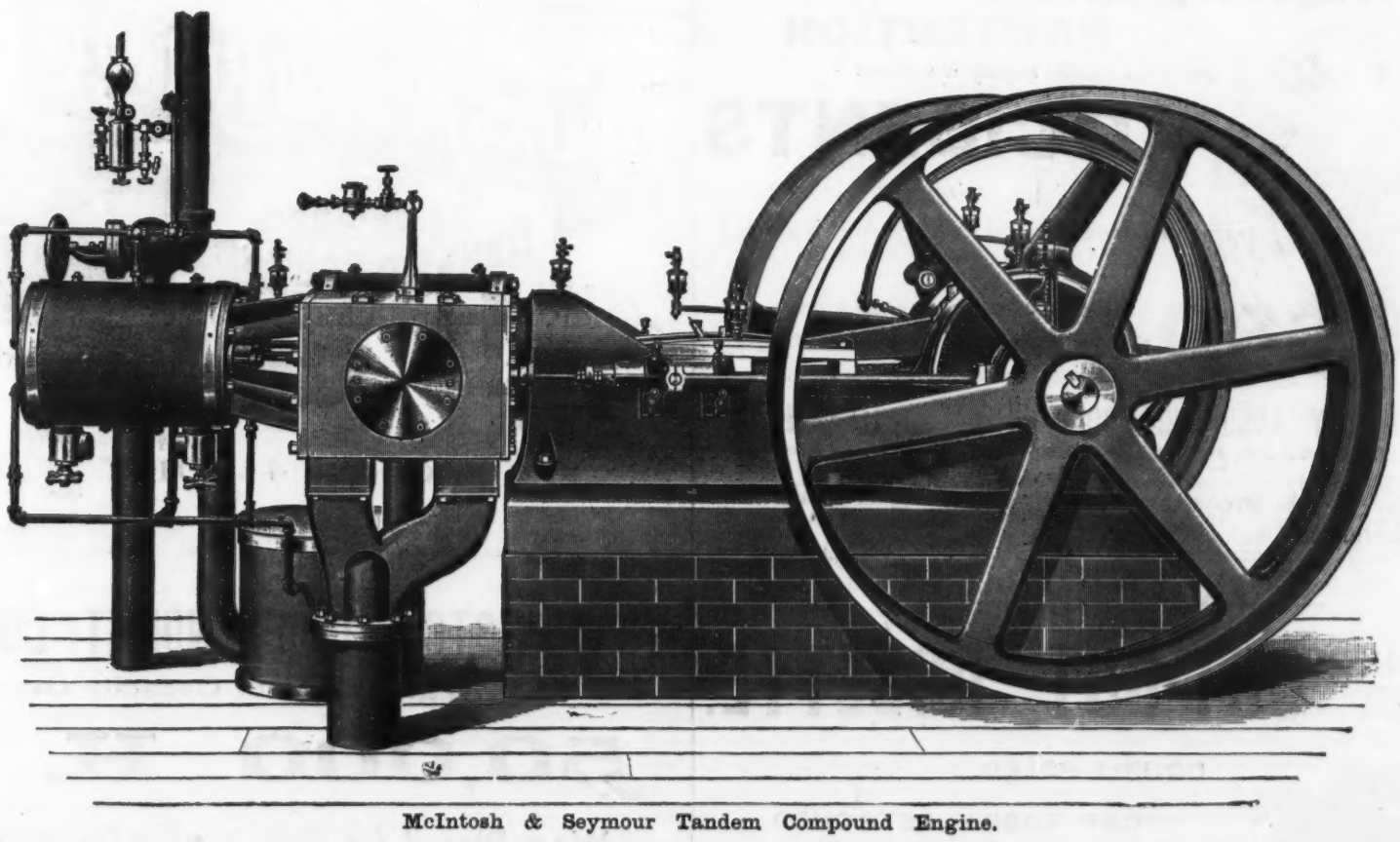

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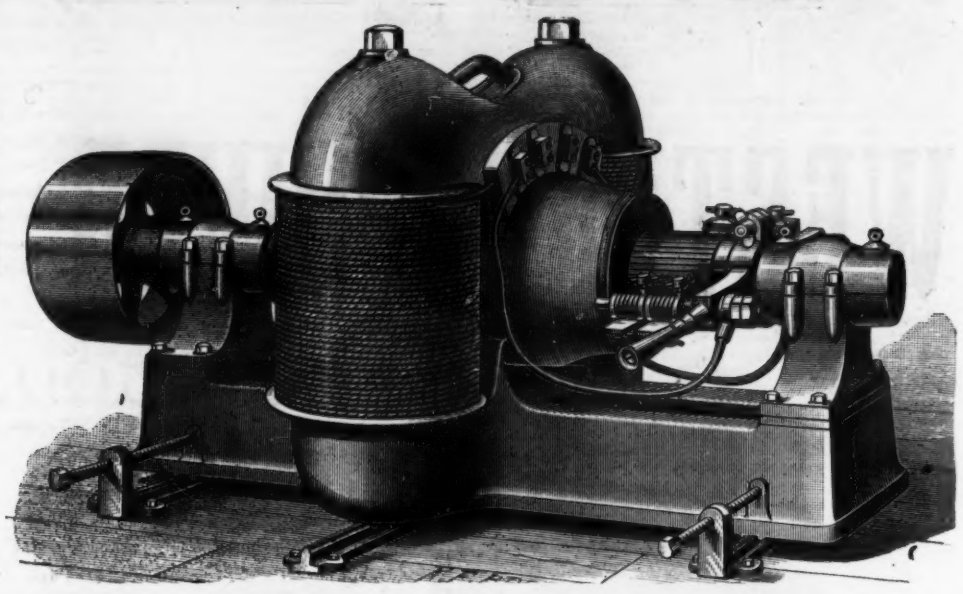

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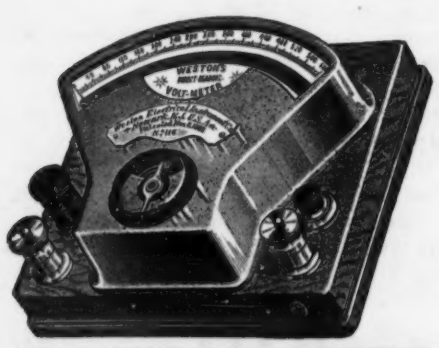

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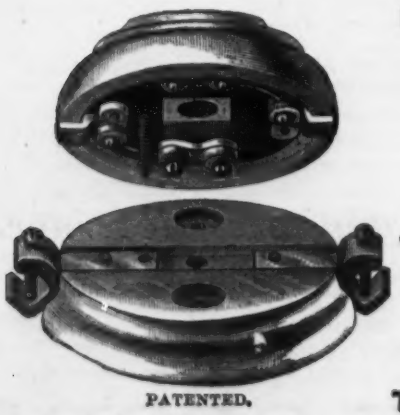

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